Design, Innovation and Software: The Impact of Gender and Language

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A thesis submitted for the degree of
Doctor of Philosophy

June, 2024

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Abstract

This thesis explores gendered communication dynamics in group settings through a series of case studies, with implications for improving collaboration, creativity, and inclusion. This research combines empirical examination of gender influences, methodological application of linguistic techniques, conceptual arguments for diversity, and design perspectives on participatory processes.

The empirical contributions uncover subtle gender differences in workshops and more balanced participation in industry teams. A pilot study suggested further investigating gender patterns, leading to a discourse analysis of an innovation workshop that reveals differences in language practices and group interactions by gender. This data was also used to analyse Hedging usage but finds no statistically significant differences, prompting more nuanced contextual analysis. Observations of software design meetings show more participation across genders versus student groups, aligning with research on gender in organisational contexts.

Methodologically, the thesis outlines combining qualitative approaches like thematic analysis, feminist frameworks, and conversation analysis to uncover gender and language issues in computer science design meetings. This interdisciplinary lens enables nuanced insights.

Conceptually, the thesis emphasises diversity alone is insufficient without empowering marginalised voices through respect and participation opportunities. Gendered language can perpetuate biases if unaddressed. Arguments are made, supporting existing research, that software development must involve diverse stakeholders throughout.

For design, the thesis advocates viewing it not as acting upon users, but as an emergent, participatory social process. Fostering inclusion and communication is vital for human-centered design.

While limitations exist, the multiple perspectives provide valuable guidance for improving collaboration, creativity, and participation across computer science settings. Further research is needed to deepen these complex insights. Overall, the thesis contributes to furthering understanding of gender dynamics with implications for more ethical and inclusive practices.

Publications

The following publication have been generated while developing this thesis, and to an extent has guided the thesis into what it has become:

Ashcroft, A. (2020b). Hedging and gender in participatory design

Ashcroft, A. (2020a). Gender Differences in Innovation Design. *OzCHI '20, December 02–04, 2020, Sydney, NSW, Australia*

Widdicks, K., Ashcroft, A., Winter, E., & Blair, L. (2021). Women's sense of belonging in computer science education: The need for a collective response. *United Kingdom and Ireland Computing Education Research conference.*, 1–7

Ashcroft, A. (2021a). Designing education applications for generation z. *15th International Conference on Interfaces and Human Computer Interaction, IHCI 2021 and 14th International Conference on Game and Entertainment Technologies, GET 2021-Held at the 15th Multi-Conference on Computer Science and Information Systems, MCCSIS 2021*, 237–240

Ashcroft, A. (2021b). Do I belong here? An exploration of meeting structure and language, alongside gender and a sense of belonging. *OzCHI '21, November 30-December 2, 2021, Melbourne, VIC, Australia*

Ashcroft, A. (2022b). I think "hedging" could be a feminist issue in software engineering. Proceedings of the 20th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing on the Design of Cooperation Technologies - Exploratory Papers, Reports of the European Society for Socially Embedded Technologies. https : / / doi . org / 10 . 48340 / ecscw2022_ep01

Ashcroft, A. (2022a). Feminist thematic discourse analysis in cs

Ashcroft, A., & Ashcroft, A. (2023). The gendered nature of chatbots: Anthropomorphism and authenticity. In M. Kuhail, B. Abu Shawar, & R. Hammad (Eds.), *Trends, applications, and challenges of chatbot technology* (pp. 36–78). IGI Global. https://doi.org/10.4018/978-1-6684-6234-8.ch003

Ashcroft, A. (2023). Reflexivity, interactions and intersectionality in hci and cscw. *Proceedings of the 36th International BCS Human-Computer Interaction Conference*

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It is literally impossible to be a woman. You are so beautiful, and so smart, and it kills me that you don't think you're good enough. Like, we have to always be extraordinary, but somehow we're always doing it wrong. You have to be thin, but not too thin. And you can never say you want to be thin. You have to say you want to be healthy, but also you have to be thin. You have to have money, but you can't ask for money because that's crass. You have to be a boss, but you can't be mean. You have to lead, but you can't squash other people's ideas. You're supposed to love being a mother, but don't talk about your kids all the damn time. You have to be a career woman, but also always be looking out for other people. You have to answer for men's bad behaviour, which is insane, but if you point that out, you're accused of complaining. You're supposed to stay pretty for men, but not so pretty that you tempt them too much or that you threaten other women because you're supposed to be a part of the sisterhood. But always stand out and always be grateful. But never forget that the system is rigged. So find a way to acknowledge that but also always be grateful. You have to never get old, never be rude, never show off, never be selfish, never fall down, never fail, never show fear, never get out of line. It's too hard! It's too contradictory and nobody gives you a medal or says thank you! And it turns out in fact that not only are you doing everything wrong, but also everything is your fault. I'm just so tired of watching myself and every single other woman tie herself into knots so that people will like us.

Barbie, 2023

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Chapter 1

Introduction: The story starts...

> Take up all the space, even when you think you don't deserve it.
> You're living your life, in your mind, you don't get it.
> Say what's on your mind, every single time, don't regret it.
>
> Orla Gartland - Things That I've Learned

The topic of Gender and Computing is not new; it is a well established area of research (Bardzell, 2010), with the statistics from various areas within the field showing discrepancies from an in-balance in the workforce (with just 11% of software developers being men (Criado Perez, 2019)), to the differences in pay (with an expectation that pay parity based on gender will not be achieved until 2069 (Deloitte, 2016)). But what remains to be seen in the research, and what this thesis outlines the beginnings of, is a more subtle and in depth understanding of the effect gender can have on way the design process takes place, and the knock on impact this can have on the software developed, the field of computing, and society at large. Can two little words, e.g. "I think", change the way in which the world engages with technology?

In short? Yes.

In length? Well, that's this thesis.

Having worked in a software development team for almost seven years, designing mobile and web applications for students, staff and the local community, the difference in how women were treated in an organisation, and particularly within a IT department, was clearly observable and was the beginnings of the motivation of this thesis. But even before this, an undergraduate thesis and a passion for equality already motivated me to look into this topic. This thesis began with the very simple and broad title of "Gender Diversity in Digital Innovation", because at the time of application, Digital Innovation was the field in this researcher was working, and therefore where the impact of gender differences was seen. What this thesis developed

and extended into was a more subtle analysis of the interrelationship between gender and language, and how this affects the products that are created, but also how this affects the *Sense of Belonging* of those involved in the processes. This change in direction can be seen throughout this thesis (outlined in Section 1.6) but ultimately leads towards the final title of the thesis;

Design, Innovation and Software: The Impact of Gender and Language

What this thesis aims to explore is design as an emergent and participatory process and understand how gendered language may pay a part in both how designers behave and how this may impact the designs that are produced. The way in which people talk to one another in business, and therefore the design process, is a type of emotional labour. Emotional labour is often gendered (Hochschild, 2019), as explored in Section 2.2, as is language (E. Stokoe, 2004), as explored in Section 2.4.2; which in turn impacts how business talk happens. What this thesis presents is a series of examples of a subtle manifestation of how language interacts with emotional labour. What this research contributes is a series of aspects of language and how this contributes to success or failure of conversation. This thesis explores themes around who speaks, who gets to speak and what gets spoken? And ultimately, how can this contribute towards the success or failure of design in Computer Science (CS)?

1.1 Diversity in CS

From 2022 to 2023 "the number of women IT Professionals and those in IT Technician roles has fallen – from 21.0% to 19.9%, and 26.3% to 25.9% respectively" (WISE, 2023). Earlier statistics show women in STEM apprenticeships are slowly increasing in numbers, but completion is continuing to drop (WISE, 2019). Therefore the gender balance in the STEM workplace is significantly different from the audience they are building for. The reasons for this discrepancy in CS are varied and debated, but this is part of a wider issue in STEM.

There are a number of areas that are affected by and can affect gender diversity in CS, from confidence affecting progression, to stereotypes and the impacts they can have, some of which will be discussed in this Section (1.1), but also throughout this thesis as relevant. Although steps being made towards parity in STEM are making an overall difference, Computer Science has not been included in this progression of equal numbers of men and women historically (Franklin, 2013) and up to the present (WISE, 2023). Franklin (2013) also suggests it is a combination of *internal* and *external* obstacles that lead to an imbalance in gender within Computer Science.

When it comes to ability, and specifically coding ability, Terrell et al. (2017) carried out a study that found that pull requests where gender is not visible, on GitHub

projects created by women were accepted more than the projects created by men. This suggests that women are not only equal in ability to men when it comes to programming, but are writing higher levels of code, if they are more likely to be accepted. This raises the question as to why this could be the case, and what factors influence this? Saujani (2016) states that "it turns out that our girls are really good at coding, but it's not enough just to teach them to code", further stating that women are taught to be perfect, whilst men are taught to take risks and act bravely. Programming is a constant process of trial and error, meaning that steps taken will be consistently wrong until a breakthrough is made. Girls are told from an early age that getting anything wrong is not acceptable, and everything must be done to a perfect standard (Dweck, 2017; Saujani, 2016). This has meant that even when women are given the opportunity to learn programming, it is more of a challenge because they are unable to do it perfectly, due to a fixed mindset. This leads to the notion that the lack of women in STEM subjects has nothing at all to do with ability, but the way society teaches them to be, in other words, having a fixed mindset (Dweck, 2017). Perhaps the average of "better" code may be higher in women because they only pursue this route if they're good at it, and therefore fail less.

Franklin (2013) expands upon these topics of *risk-taking*, *confidence* and adds *communication*. As students progress "to higher education, more emphasis is placed on thinking outside of the box and independent work, both of which benefit from being willing to take risks" and they state that "women are less likely to take risks than men" (Franklin, 2013). This ties into the second risk raised, which is confidence. If women have a lack of confidence, they will also be less inclined to take risks. This lack of confidence will then lead to female students "choosing easier projects" in order to "guarantee success" and this will "lead professors to believe the students are less intelligent or knowledgeable than they really are" (Franklin, 2013), supporting the work of Dweck (2017).

The final risk raised is that of communication. "Differences in communication patterns taught from a very young age have a negative effect on females[1] both in group projects and when interacting with faculty" (Franklin, 2013). This difference in communication styles can lead to females expressing "submissive emotions, ones that do not negatively affect others, such as sadness and anxiety" and males expressing "strong, combative emotion". These differences in communication style could often lead to women being overlooked in a group setting (this is discussed in significantly more detail in Section 2.4). This ties into literature around emotional labour, and how this is impacted by gender, as outlined further in Section 2.2.

Franklin (2013) also raises external obstacles which lead to the gender imbalance

[1] "Females" generally now refers to sex, and "woman" refers to identity. The differences of this are discussed further in Section 1.5.2, but in order to not misrepresent existing literature, "female" and "male" are still sometime referred to in quotations or in referencing existing literature.

including; male dominated evaluators and peers, gender roles, stereotype threat and discrimination. As mentioned previously, men and women have different communication styles due to taught behaviours. These differences often mean that women who adopt a more male communication style are more likely to progress in their careers (Franklin, 2013). Again, communication styles are more apparent in group work and therefore a group setting is the best way of observing differences in styles. Franklin (2013) poses that "the more male dominated the group is, the less a woman will both be allowed to and desire to contribute."

Tannen (1994) observes that in small mixed gender groups, where there were "far more women than men", "when it came to present small-group findings to the class, each group that included a man had chosen the man to stand up and be the spokesperson." This reinforces that men are much more likely to speak for the group. Tannen (1994) also suggests that it is a manager's role to notice behaviour which silences women, and not for women to change their communication style (discussed further in Section 2.5).

Gender roles and expectations are described as "the new sexism" by Franklin (2013), and that "many people believe that because hostile sexism, for example firing women when they become pregnant or get married, or not hiring them in the first place because they may get pregnant, is rare—equality has been attained" (Franklin, 2013). Although hostile sexism may have been significantly reduced, sexism still lies in the underlying, and often subconscious gender roles society places on itself, also called 'benevolent sexism' (Franklin, 2013). The most profound example of this is 'complimenting' women, as outlined in the quote below:

> "*Examples would be telling a female computer science student she should take notes because she is so good at it (with no more knowledge about her than her gender), compliments on a female's appearance (hair, clothing, jewellery) after a technical talk, obituaries that, regardless of a woman's accomplishments, list her motherly and wifely accomplishments first.*" - Franklin (2013).

The third external obstacle outlined by Franklin (2013), is "stereotype threat". The perceived stereotype by both genders, can lead to increased anxiety around performance. If a woman is focusing on overcoming a stereotype, as well as successfully completing a task, and a man is only focusing on completing the task then the woman's attention will be divided (Franklin, 2013). If women are performing at the same level even with the stereotype threat, one could argue that they are showing further competency. It has been shown that when statistical analysis is carried out on test results between male and female students where men are preforming higher, and the stereotype threat is removed, then the differences in results between male and female students significantly decreases (Franklin, 2013).

Discrimination is the fourth and final external obstacle described by Franklin (2013). They discuss a study carried out by MIT in which they found senior faculty members who were female "were systematically discriminated against in small but increasing ways throughout their careers, with senior females experiencing more inequity than junior females". This shows that although hostile sexism is decreasing, that sexism and therefore discrimination are still strongly apparent in society.

1.2 Justification for the Research

Vitores and Gil-Juárez (2016) label four issues around the representation of Women in Computer Science and their potential solutions. The first of these is to make alternative histories available. "Computing has been coded as a male profession not in one obvious and natural step but through co-evolving gendered and gendering processes regarding specific labour-power relations, activities, skills, identities and artefacts" (Vitores & Gil-Juárez, 2016). The second solution suggested by Vitores and Gil-Juárez (2016), is making non-western realities visible, as it is more common in western societies to force gender into a binary. They suggest that in doing so, this will undermine the idea of masculinity and computing and give a chance to "dismantle both what is regarded as 'masculine' or 'not feminine' and what 'computing' is in the first instance". The third solution is to make other contributions visible, and that by making these contributions visible, this will show society the strong value that women have and the impact they can bring to the world of Computing. The fourth solution to make women who enjoy computing visible. It is suggested by the authors, that it is possible to search out information on women who are in the field of computing and IT, but it is more challenging to find the women who did not enter or those who left the world of computing (Vitores & Gil-Juárez, 2016). Perhaps, it is those women we can learn the most from on how to achieve full equity in Computer Science. Research including asking women why they chose to *leave* the field of Computing was carried out by Holtzblatt and Marsden (2018b), who found a variety of reasons for women remaining and leaving CS, and, perhaps more importantly, why they stayed, which led to the following themes;

- Overall experience
- Team
- Projects
- Push and support
- Role models

- Becoming a manager
- Nonjudgmental flexibility
- Personal power

Other research by Farnsworth and Holtzblatt (2016) found that there were a number of more in depth, but similar, factors that led to women remaining in CS, which should be considered, particularly in line with how women feel they belong (see Section 2.9).

> "*Initial findings indicated that the most important interventions are within the daily life and management of women. These include:*
>
> - *A dynamic, valuing team they feel connected to,*
> - *Stimulating, impactful work produced with the team,*
> - *"The Push" to new challenges with support to succeed in them,*
> - *Role models living a desirable work and home life,*
> - *Nonjudgmental flexibility to deal with balancing home and work commitments."*
>
> - Farnsworth and Holtzblatt (2016)

Both of these pieces of research contribute to the notion that there needs to be a larger conversation taking place around retaining talent in the sector (Farnsworth & Holtzblatt, 2016; Holtzblatt & Marsden, 2018b). Vitores and Gil-Juárez (2016)' suggestions to promote the equality of gender in Computer Science is succinctly summarised by their fourth solution. By promoting the visibility of women in Computer Science, from across the world and sharing their success, this may help to break down barriers in all areas of society. However, this must be done by all those who share and promote the history of Computer Science, and this could be the biggest challenge of all.

The significance of the contribution of this thesis lies in its exploration of the relationship between gender dynamics, communication patterns, and design within the field of Computer Science. As software development and design processes continue to shape the technology that underpins our daily lives, it has become vital to understand how gendered language and behaviour influence these processes. This research is motivated by the recognition that while representation is crucial, it is equally vital to ensure that marginalised voices are not only present but also heard, respected, and provided with equitable opportunities to contribute.

Designing technology that truly serves the diverse needs of its users requires a comprehensive understanding of how communication dynamics impact the design

process and its outcomes. This research aims to address this need by exploring the implications of gender-influenced communication patterns in design meetings and software development teams. By investigating concepts such as 'Hedging', interruptions and other traits of conversation, emotional labour, and project work through the lens of gender, the research strives to reveal how these phenomena affect the accomplishment of design within Computer Science.

Furthermore, this research seeks to expand the literature on design by advocating for more inclusive and participatory design processes. It underscores the importance of recognising that design is not merely about creating functional products, but about fostering positive interactions, mitigating power imbalances, and ensuring that all voices are heard throughout the design journey. By bridging the gap between the insights from linguistic and feminist methodologies and applying this within Computer Science, this research aims to contribute to more ethical, inclusive, and human-centered design practices.

Overall, this research is motivated by the need to reshape our understanding of design within the context of gender dynamics and communication, with the ultimate goal of promoting equitable participation, diverse perspectives, and successful design outcomes.

1.3 "But is it Computer Science?"

> We don't want to be condemned for being multifaceted.
>
> Taylor Swift - Miss Americana, Netflix Documentary

Computer Science's equivalence to coding can create a 'gatekeeping' culture that inadvertently discourages women and underrepresented groups from participating in the field (Margolis & Fisher, 2002). By defining computer science as solely 'coding', the discipline may inadvertently send a message that it is exclusive and unwelcoming to those who don't fit the stereotypical 'coder image'. This limiting perception can deter women and other marginalised individuals who may not initially identify with coding or feel connected to the traditional male-dominated tech culture.

By embracing a broader scope that encompasses interdisciplinary intersections, such as linguistics or sociology, CS can break down barriers to entry for marginalised groups and create a more inclusive environment. Recognising the diverse talents and contributions that individuals from different backgrounds can bring to the field fosters a sense of belonging and empowers underrepresented groups to pursue computer science (Mooney & Becker, 2020). Emphasising the importance of human-computer interactions, language processing, and social dynamics acknowledges the varied skills and interests that women and minorities may possess and highlights the many ways

they can thrive in the field beyond coding. This shift in perspective has the potential to cultivate a more welcoming and supportive space within CS, encouraging greater diversity and enriching the discipline with fresh perspectives and innovations.

1.4 Research Questions

This research is driven by a set of pivotal research questions founded as an output of the literature review carried out in Chapter 2. Each of these questions is aimed at exploring the complex dynamics within CS design meetings and their broader implications. These questions serve as a compass, guiding the investigation towards a more inclusive understanding of design processes in the context of CS.

The first research question (**RQ1**) focuses on identifying which factors contribute to the production of project meeting outcomes. Within this question, a sub-question (RQ1.1) focuses on the impact of gendered language and behaviour on meeting accomplishment, addressing potential barriers and biases that may arise. The concept of 'production' is based on the notion that activities of almost any kind are 'produced' through various forms of social interaction. The use of 'production' rather than 'construction' derives from this emphasis on action, social interaction and also because 'construction' is often associated with a form of critique – that something is 'merely' a social construction, that you are trying to avoid. 'Production' refers to the ongoing, emergent linguistic work that leads to specific results. This preference comes from Garfinkel, who as Lynch tells us: "never embraced the word 'construction' or any of the variants of constructionism that became emblematic of social studies of science. In part, this was because he reserved the term 'constructive analysis' for reference to the sociological practice of constructing models and indicators that stood proxy for the concrete 'society' that was always beyond methodological reach. He preferred the term 'production' to 'construction', perhaps because it implicated action and performance, and was less easily confused with a common idiom in the sciences to discredit findings as (often unwitting) products of artifice." (Lynch, 2011).

The second research question (**RQ2**) pivots towards methodology, seeking to unearth the most appropriate methods for uncovering the influential factors shaping design meetings. It also prompts the discussion of the relevance of integrating existing feminist methodologies within these investigative approaches, recognising the potential for enriching insights from interdisciplinary perspectives. RQ2 assesses the role of feminist conversation analysis as a device for understanding interaction in meeting and asks what thematic analysis can bring to our emerging understanding of relevant issues.

Regarding more conceptual explorations, the third research question (**RQ3**) aims to identify the most pertinent concepts for comprehending design achievement in CS. Two sub-questions (RQ3.1 and RQ3.2) further break down the interaction between

these concepts and gender dynamics, shedding light on how notions such as Hedging, interruptions, emotional labour, and project work are affected.

Lastly, the fourth research question (**RQ4**) focuses on the consideration of the implications of these findings on the broader field of design within CS: and to address the impact of this research on redefining success and failure within design practices, steering the discipline towards a more inclusive and human centered approach.

- **RQ1 - What influence does gendered language have in the production of project meeting outcomes?**
  - **RQ1.1** - To what extent does gendered language and behaviour impact the accomplishment?
- **RQ2 - What methods are the most insightful for uncovering factors that impact how design meetings are accomplished?**
  - **RQ2.1** - How can these methods be informed by existing feminist methodologies?
- **RQ3 - What concepts prove most useful in the examination of gendered interactions in project meetings?**
  - **RQ3.1** - How are these concepts affected by gender?
  - **RQ3.2** - How is design impacted by concepts such as Hedging, interruptions, emotional labour and project work?
- **RQ4 - What are the implications for design of this research?**
  - **RQ4.1** - How does this impact our understanding of success or failure in design?

1.5 Definitions

It is vital to outline the definitions that underpin this thesis. An outline of the concept of diversity is outlined below, which encompasses the variation in physical and emotional attributes between individuals, including underrepresented characteristics and protected characteristics under the UK's Equality Act (Section 1.5.1). Following this, presented is a definition of the multifaceted notion of gender, emphasising its distinction from biological sex and the historical biases that have shaped its understanding (Section 1.5.2). Following this, Intersectionality is defined, providing a crucial framework that acknowledges the intersection of diverse identities and highlights the importance of considering race and ethnicity alongside gender. Finally,

a definition of design is presented: recognising its subjective nature and how design plays a role in planning and organisation across various disciplines. Further relevant literature is outlined in the Literature Review (Chapter 2).

1.5.1 What is Diversity?

Diversity must be defined when gender is discussed, as often "gender" is seen merely as one flag of diversity. Diversity can be defined as the variation on physical and emotional attributes between people. This could be anything from gender and race, to varied lived experiences. It could, and perhaps should, be argued that diversity is impossible to measure, because the lived experience of every person is different, and yet there are characteristics that are under-represented or due to historical bias and prejudice still being present, that lead to certain groups being treated differently. A measurement of diversity is, after all, "when the individuals of a population are classified into groups" (Simpson, 1949). One of the ways of grouping people is, in the UK, the 2010 Equality Act which states eight protected characteristics; age, disability, gender reassignment, marriage and civil partnership, race, religion or belief, sex and sexual orientation ("Equality Act 2010", 2019). Although other characteristics are not protected under the Equality Act, other types of diversity include; "socioeconomic background/class diversity, education, life experiences, personality" ("What are the types of diversity? — Workable." 2019).

> "*Diversity has often been studied in an indeterminate manner; that is, the substantive meaning or constitutive definition of diversity often is not clearly specified*" - Konrad et al. (2006).

Konrad et al. (2006) also outline the difference between 'actual' and 'perceived' diversity, and it could be taken from this that the more measures of diversity that are put in place, the more problems occur as patterns are attempted to found between each element, as opposed to focusing on the area of study. This would, of course, be problematic, but even with this consideration in mind, it seems vital to uncover any issues caused by prejudices or how people have been raised due to any characteristics which they hold, which lead to their unfair treatment. Therefore, diversity should not only be considered as an area of research, but considered whenever any research is carried out (see Section 3.1).

Unfortunately, in the context of the thesis, it is not possible to examine all areas of diversity named above, and gender remains the main focus of research throughout. However, acknowledgements are made, where possible, and an understanding of other areas of diversity have been applied, where they may be relevant for future work.

1.5.2 Gender

> Gender is not an easy conversation to have.
> It makes people uncomfortable, sometimes even irritable. Both men and women are resistant to talk about gender, or are quick to dismiss the problems of gender. Because thinking of changing the status quo is always uncomfortable.
>
> Chimamanda Ngozi Adichie - We Should All Be Feminists

In this research, gender will be used to refer to self-selected identity and if sex is discussed, this will be in reference to the biology. Although, sex is made up of five biological factors (Tannenbaum et al., 2019), which most people will never learn about themselves in a lifetime, showing that the emphasis should be on gender and not sex. This research will be focusing on *gender*, but in existing literature, sometimes these terms are used as synonyms; this will be addressed where necessary. It is also important to consider the work of Zhu and Chang (2019) who state that one of the greatest challenges is determining the difference between gender roles and gender inequality; this should therefore be considered once gender has been defined.

Looking into gender and where the concept of this has been debated in research, the book "The Gendered Brain" states that "the question of sex differences in the brain is one that has been debated, researched, encouraged, criticised, praised and belittled for over 200 years" (Rippon, 2019). Rippon (2019) takes the reader through the history of research into gender and sex, when they were often seen as the same, and how often research deliberately looked for differences and concluded that the physiology of the brain was different, and improper research practices were used to come to these conclusions. Most of this research was based on the assumption of sex-based difference; Rippon (2019) quite comprehensively discusses that this improper research throughout history has been used as a basis for fact, and research has been built upon this. Therefore, however inadvertently, these stereotypes and biases were carried forward into more recent research. Therefore, feminist practices (again, explored in more detail in Section 3.1) will be carefully carried out in this research. That is to say, it will be acknowledged that any existing research could have relied upon or been altered purposefully or inadvertently due to patriarchal bias (O'Leary, 2017). In the same vein, gender will have affected how those involved in the research (participants, or the researcher) will behave and see the world; in other words:

"*A gendered world will produce a gendered brain.*" - Rippon (2019).

This author, supported by existing literature, feels it is important to consider how gender and sex differ when exploring any topics surrounding gender.

"Gender" is socially constructed and this has been widely discussed when it comes to the gender vs sex "debate" as the action of "doing gender" (Jurik & Siemsen, 2009; New, 2006). Although not an academic reference, one of the most succinct and coherent summaries, in the opinion of this author of the differences between Genitals, Sex and Gender, was posted in early 2022 by, YouTuber, Witton (2022). Witton explains the differences between Gender (which refers to identity) and Sex (which refers to Biology) from well established research in the medical field (Miguel-Aliaga, 2022; Tannenbaum et al., 2019). Witton shared a more nuanced approach to gender, as supported by publications such as The Transgender Issue by Shon Faye (Faye, 2022).

Figure 1.1: Thumbnail taken from the video "*Why We're Not Finding Out Our Baby's "Gender"*" by Witton (2022).

Looking deeper into these definitions in academic publications, one of the best explanations of the differences between sex and gender is that from Tannenbaum et al. (2019);

> "*In biology, sex describes differences in sexual characteristics within plants or animals that go beyond their reproductive functions to affect appearance, physiology or neuroendocrine, behavioural and metabolic systems. In engineering, sex includes anthropometric, biomechanical and physiological characteristics that may affect the design of products, systems and processes.*
>
> *Gender refers to psychological, social and cultural factors that shape attitudes, behaviours, stereotypes, technologies and knowledge. Gender includes three related dimensions. Gender norms refer to spoken and unspoken rules in the family, workplace, institution or global culture that influence individuals.*
>
> *Gender identity refers to how individuals and groups perceive and present*

> *themselves within specific cultures. Gender relations refer to power relations between individuals with different gender roles and identities.*"
>
> - Tannenbaum et al. (2019)

Showing that neither gender *nor* sex is simply external genitalia, and that questions regarding this are not only inappropriate in most situations, but are not likely to even give the person asking for the information, any information at all.

> "*When somebody learns that a person is trans, their first instinct is usually to ask details about that person's surgical status.*" - Faye (2022)

It is clear that this understanding of the difference between genitals, sex and gender has not yet broken out into mainstream culture, with "trans exclusionary radical feminism" being consistently debated (Faye, 2022), although the topic of gender identity and expression has certainly made some progress (for example, workshops being run on the topic in HCI spaces (Quinn et al., 2021)).

Therefore throughout this research, **gender** will be used to refer to identity, and **sex** will only be referred to when appropriate, for example its use in the literature being cited or data being used. Only this nuanced understanding of gender, will allow Intersectionality to be understood and considered to the extent it should be, when thought of in relation to this, or any, research.

1.5.3 Intersectionality

> How can I define white privilege? It's so difficult to describe an absence. And white privilege is an absence of the consequences of racism.
>
> Reni Eddo-Lodge - Why I'm No Longer Talking to White People About Race

It is key to understand Intersectionality when conducting any research into minority groups, as Intersectionality allows for the understanding that it is the entirety of a lived experience that impacts interactions. The true definition of Intersectionality is one that understands the theories that first brought it forwards, namely Black Feminist Theory (De Hertogh et al., 2019). However, in literature and in many CS spaces, the term is used with regards to its linguistic definition as simply the cross over of multiple attributes, without any understanding of the white-washing this perpetuates.

> "*Intersectionality is a theoretical product of black feminist thought – so whilst strongly related to feminist methodologies, it is also distinctly*

> *important in its own right. Many trans people are "highly aware and sensitive to the value of intersectionality."*" - Vincent (2018)

Therefore, it is also important to consider that Intersectionality in itself has different definitions to various groups. In this discussion, it will be taken to mean diversity including, and never discounting, race as well as gender diversity. Furthermore, it could be argued that to carry out true intersectional feminist research, that a representative of any group of people must be present in any study. However, as is to be understood with all research this is not always possible, especially when it comes to gender fluidity as they are a minority group (Gov.uk, n.d.). In a 2017 government survey, "thirteen percent of the respondents were transgender (or trans)" and "6.9% of respondents were non-binary" (Gov.uk, n.d.). Furthermore, although "respondents were younger, on average, than the general UK population", younger people were still more likely to identify as LGBT+ (Lesbian, Gay, Bisexual or Trans). This is particularly interesting as the first part of this research uses University students, of a similar demographic, and the impact that this may have on the make up of participants in the industry setting should also be considered.

Morris and Bunjun (2007) plainly state; "Intersectionality is not easy. But it is necessary to try our best to do respectful and representative research that seeks innovative and inspiring solutions that actually work for specific populations who are themselves complex and diverse." It is this attitude that will be carried through this research.

In the popular anti-racist self-improvement book "Me and White Supremacy", Saad (2020) recognises that change can only happen when those with privilege reflect, supporting Strohmayer et al. (2019) and Vincent (2018).

> "*This work – which is a combination of learning and reflective journaling – will create a deep shift in consciousness and action within you to help create a world without white supremacy.*" - Saad (2020)

Research output, affected by its methodologies, must follow the same practices of self-reflection. Could the privilege of the researcher, or the participants, disadvantage other participants, or society at large? Extra care must be taken in this research, as this author is white, and therefore it is not simply enough to assume any bias would be conscious. Regardless of the diversity in discussion; gender, race, ethnicity etc., there is seemingly an agreement that self-reflection and transparency regarding methodologies are key. However, it is always important to recognise how race, gender or any attribute can also individually affect research, especially when these overlap. Reflexivity and the positioning of the researcher, focuses on privilege and viewpoint, and the effect the researcher has on the data collection (Rode, 2011b), and considering

the topic of research this should be embedded in any research carried out, and is therefore discussed in more depth in Chapter 3.

The implications of this methodologically and throughout this research is explored more in Chapter 3 where the methods used in this thesis are outlined.

1.5.4 Design

> Design is when designers design a design to produce a design.
>
> John Heskett, Toothpicks and Logos

The above quote by Heskett (2001), was presented at the EUSSET Summer School 2023, and it struck a chord. It led this author to reflect upon this Section of this thesis, and contemplate the need for the definition. Throughout literature, and across disciplines, there are varying definitions for "**design**". Some coin the term for wider use, such as Lauer and Pentak (2011), whilst others apply it strictly to their niche, with little room for negotiation. In this thesis, the definition for design is broad, and a "you know it when you see it" approach is taken, supported by the literature outlined below.

> "***What do you think of when you hear the word design?*** *Do you associate design with fashion, graphics, furniture, or automotive style? Design has a more universal meaning than the commercial applications that might first come to mind. A dictionary definition uses the synonym plan: To design indeed means to plan, to organize. Design is inherent in the full range of art disciplines from painting and drawing to sculpture, photography, and time-based media such as film, video, computer graphics, and animation. It is integral to crafts such as ceramics, textiles, and glass. Architecture, landscape architecture, and urban planning all apply visual design principles. The list could go on. Virtually the entire realm of two- and three-dimensional human production involves design, whether consciously applied, well executed, or ill considered.*"
> - Lauer and Pentak (2011)

The stereotype of design being subjective, seems to also apply to its *definition*, and it could be argued that any true definition of design should allow for this flexibility and subjectivity in and of itself.

When considering Computer Science and Design, often the first element of consideration is that of Front End (FE), User Interface (UI) or User Experience (UX), i.e. the visual components displayed to end users. However, design can be

much broader, both within digital spaces or in non-digital spaces, or much more specific than this depending on the context.

Back end development, for example of system architecture, also requires design and will have an impact on the designers, developers, and users. There are also areas to consider which may not first seem to be CS at all, such as more physical components (e.g. the shape of a mouse, or the size of a phone). Therefore it is important that throughout this thesis that the definition and understanding of design is consistent, in order to ensure that any overlaps or correlations found are accurate and true.

The definition applied within this thesis will be **planning with consideration** (Lauer & Pentak, 2011). Which includes design as both a concept for research and a means of research, outlined further in Chapter 3.

1.5.5 The Aims of Design

What literature, however, can seem to agree on is that the aims of a design process should be well thought out and clear, in order for the best design to be made (Harrison et al., 2007), regardless of the discipline or the element of Computing that this is applied to.

HCI and UX are well established fields within CS, and are often the first areas considered when it comes to design (Marcus, 2015). However, as mentioned above, if we take design to mean the consideration or planning, this is not exclusive to the direct interaction between users and the systems or artifacts being created, but every layer and decision that has been built or made in the process. Each of these will have been 'designed' in some way.

The aims of design are discussed in great detail through existing HCI paradigms, with the importance of "values in design" being brought forwards more recently (Harrison et al., 2007).

1.5.5.1 The Three Paradigms of HCI and their Implications for Design

The Three Paradigms of HCI, illustrate how the paradigms shifted over time and is outlined by Harrison et al. (2007) to include;

- Human Factors
- Cognitive Revolution
- Situated Perspectives

Using this model, "the first two waves of research in HCI" are categorised by these first two paradigms. The goal of the first paradigm, Human Factors, is to "optimize the fit between humans and machines" (Harrison et al., 2007), with the

idea being that anything being designed should focus on developing solutions to problems that have been identified. Harrison et al. (2007) state the second paradigm, Classical Cognitivism, is in contrast to this, and "is organized around a central metaphor of *mind and computer as coupled information processors*". In outlaying newer areas of research, Harrison et al. (2007) suggest that a new paradigm shift has occurred, towards Phenomenologically-Situated HCI, and lay out six principles of their suggested third paradigm; the construction of meaning, putting users in their place, putting interfaces in their place, putting researchers in their place[2], explicit focus on values in design (as mentioned above), and "the necessity, but inadequacy, of theory". Tying this back into the work of Dourish (2006) and the implications they laid out for design[3], Harrison et al. (2007) state the need for the paradigm in which design is being carried out to be stated in in all publications and research. How this fits into design and innovation processes at large, can be understood by defining Design Thinking.

These paradigm shifts support the idea that design was previously more often than not, particularly within CS, a solo activity, as the emphasis is now on "the element of enquiry" (Harrison et al., 2007). Which is why personality traits were monitored with mindset categories such as Myers-Briggs (Myers, 1962) or Enneagram (Riso & Hudson, 1996). What bears consideration in these later HCI paradigms is the notion of how work and design gets done through conversation (discussed further in Section 2.1).

1.5.5.2 Design Thinking

Mootee (2013) uses the concept of '**Design Thinking**' almost interchangeably with '**Innovation**' through their book "Design Thinking for Strategic Innovation: What they can't teach you at business or design school", stating that applying "design thinking is strategic innovation". Mootee (2013) also states that when it comes to defining Design Thinking; "there is no single, unifying, common definition of Design Thinking. Given its predilection for dealing with ambiguity, perhaps there shouldn't be." What is stated however, is that Design Thinking can be an approach to take on design challenges using empathy and problem solving, as well as a framework

[2]Harrison et al. (2007) refer to the situation of knowledge and users and researchers having different positions, however the concept of putting anyone in their 'place' is perhaps not appropriate wording. Although the sentiment of their paper is very much about inclusivity, the wording reminds this author of putting people down and in their place, as opposed to in a place where they can be listened to.

[3]Dourish (2006)'s work stresses the significance of designing interactive systems that consider users' emotions and preferences, while ensuring intuitive and user-friendly interfaces. Their insights highlight the importance of offering choices and personalisation to create positive and engaging user experiences.

that fosters experimentation "and more" (Mootee, 2013). Their complaint of an over simplification of Design Thinking, is one that resonates with the lack of structured definition of Design itself (as discussed in Section 1.5.4).

1.6 Thesis Outline

This thesis outlines existing themes surrounding gendered language and innovation and business practices in CS. Specifically, this thesis focuses on communication dynamics within various contexts, aiming to uncover the nuances of gender-related patterns and their implications for fostering creativity, collaboration, and inclusivity. The chapters presented show a series of case studies, each contributing unique findings and highlighting the importance of a more subtle understanding of communication dynamics within CS, using methodologies combined from other established fields.

Chapter 2 explores the concepts addressed in the Research Questions, and the literature surrounding the gap this thesis aims to fill. Chapter 3 describes the methods used in each of the Chapters outlined below.

Chapter 4 served as a pilot study for running innovation workshops, and highlighted areas for improvement when it came to the practical running of these. This pilot study showed basic observations of gender differences in language.

Chapter 5 describes further innovation workshops within a university setting. Here, gender dynamics manifesting through language use and group practices were observed, identifying the critical area of design processes for further examination. Chapter 5 also included a basic statistical analysis of Hedging usage. Although the study revealed no statistically significant gender differences due to the small sample size, this prompted further investigations into the implications of these findings for design processes.

Unfortunately, the Covid-19 pandemic disrupted the ability to conduct in-person workshops. Therefore, an online approach in Chapter 6 was piloted. Through this additional pilot study, the impact of technical difficulties and the online environment on workshop dynamics was explored, reinforcing the observations of gender-related patterns in idea generation. The findings of this study also showed that the methodologies could be used on online recordings and therefore the data from this Chapter was used in the final conclusions.

The continuation of this research led to the observations of a development team throughout various meetings, presented in Chapter 7. This phase of the research involved observing communication dynamics between participants, uncovering context-specific variations compared to previous chapters and the significance of fostering inclusive team cultures. The leadership approach and emotional labour, drawing on the work of Hochschild (2019), demonstrated by the leader of the industry team offered intriguing insights into the impact of gender dynamics in such settings. The

industry case study unexpectedly led to discussions on LGBT and gender topics (as this wasn't known to be the topic - the researcher expected only project updates) accentuating the need for more ethical and inclusive practices in Natural Language Processing (NLP). This outcome reinforced the importance of the research regarding gendered language in technology and highlighted the relevance of the findings beyond traditional communication dynamics.

In conclusion, this series of case studies has provided a comprehensive exploration of communication dynamics within fabricated settings and a software design team. The implications drawn from these findings offer valuable insights for fostering creativity, collaboration, and inclusivity in future endeavors. By applying existing methodologies, this thesis outlines ways to apply these insights effectively in computer science settings. Furthermore, the examples encountered throughout this thesis have both supported and challenged existing research concerning gendered language in computer science.

1.7 The Contribution of the Thesis

This thesis represents an exploration of communication dynamics within different contexts, exposing insights into the fostering of collaboration and inclusion. Through a series of case studies, this research delves into the interplay of gender and language in software design processes and group interactions, contributing to the understanding of gender dynamics in computer science design.

The contributions of this thesis are as follows; the findings from the innovation workshop study in Chapter 5 unveil subtle yet significant gender differences in problem framing and language use, substantiating existing linguistics research on gender conformity (Kitzinger, 2008; Lindqvist et al., 2019). While the Hedging analysis in Chapter 5 compiles gendered language practices, the absence of significant quantitative differences prompts a call for further contextual analysis. This was searched for in the industry case study in Chapter 7 which reveals more balanced participation compared to student groups, aligning with research on gender and organisational talk (Boden, 1994). These empirical findings underscore the intricate and multifaceted nature of gender influences across various settings.

Methodologically, this thesis demonstrates the combining of qualitative techniques such as thematic analysis, feminist frameworks, and conversation analysis to investigate gender and language issues in computer science design processes, which led to further publication (Ashcroft, 2022a). This interdisciplinary approach allowed the unveiling of subtle dynamics that might have been overlooked by other methods and providing a more comprehensive understanding of gender dynamics in computer science contexts.

Conceptually, the thesis emphasises that gender and language within design

may influence one another. It highlights the impact of language and its interplay with gender and how this may influence the design process. Gendered language practices, if left unaddressed, may perpetuate biases and impact both the designers and the designs. This underscores the importance of employing a case study that involves diverse perspectives in software development (Harrington & Dillahunt, 2021). Furthermore, this research contributes to the literature which advocates for a paradigm shift in design, viewing design as not merely acting upon users, but as an emergent, participatory process supporting existing research (Harrington et al., 2019). By fostering inclusion and open communication, human-centered design can be successfully achieved, but not just one type of human should be considered. The thesis identifies a research gap, calling for a more holistic examination of gender, emotional labour, language, and design to uncover their potential impact.

In conclusion, this thesis contributes to the understanding of gender dynamics and language in CS design. While limitations like small sample sizes call for further research, the combined empirical, methodological, conceptual, and design perspectives provide valuable guidance for enhancing creativity, collaboration, and inclusion in CS fields. The case studies and findings, as well as the methods, presented in this thesis serve as a stepping stone towards creating a more inclusive and equitable future for the design and CS community.

Chapter 2

Literature Review: This is a worthwhile fight.

> I'd be a fearless leader, I'd be an alpha type.
> When everyone believes ya, what's that like?
> I'm so sick of running as fast as I can.
> Wondering if I'd get there quicker, if I was a man.
>
> Taylor Swift - The Man

Some of this literature review informed much of a publication from OzChi in 2021 (Ashcroft, 2021b), but amendments have been included in this thesis to expand upon areas and add more clarification where needed.

Through an examination of the existing literature, the main areas discussed in this chapter include; how business is conducted through talk (Section 2.1), Emotional Labour (Section 2.2), innovation (Section 2.3), language and gendered language (Section 2.4), meeting structure (Section 2.5) and how this plays into power dynamics in group settings within CS. What this Chapter aims to address is how existing empirical and methodological contributions from literature in Sociology and Linguistics can be applied with CS, and the literature surrounding this gap. Gendered language is a well established and well researched field (Holmes, 1986; E. Stokoe, 2004) but the direct impact that this has on the products designed, and how the people in this process (and in these meetings) feel they belong as a result of this remains to be seen. The outline of this literature shows the gap, and therefore the need, for this thesis. Although these areas have all been researched individually with some overlaps, the argument made in this thesis is that they are all implicitly linked, and yet how they are linked and the impact this can have has not been researched in the existing

literature.

2.1 The Business of Talk, Meetings and Project Work

Boden (1994) in their book "The Business of Talk" outline the way in which conversation is what drives business forwards from water cooler moments to board meetings; conversation is what propels progress. Similarly, this ties into the existing literature regarding "Project Work", how projects move forwards, and how conversation allows project work to happen. Procter et al. (2011) observe that dialogue works as an effective layer when managing the emotional labour of participants in meetings, as well as acting as a way to "keep the project on track" when it comes to Agile Methodologies (discussed further in Section 3.3). Button and Sharrock (1996), observe meetings which attempt to solve "a considerable "correspondence" problem" which is "involved in the organisation of project work" where participants share project updates. Sharing update on the work contributing to a project, and what is yet to be completed are generally done through talk (or in the case of some businesses or circumstances, digital chats e.g. Skype updates observed by Procter et al. (2011) or at hackathons observed by S. J. Brooke (2022)).

To drive projects forwards, conversation must take place, and how this conversation is observed and analysed is discussed extensively by Boden (1994) who understand that Conversation Analysis is most often the most appropriate way to do this as it focuses on how the conversation progresses; "conversation analysis, in contrast to other linguistic or socioliguistic approaches, concentrates on the sequential and interactional properties of action", described similarly by E. Stokoe (2018) as "the conversational racetrack".

The patterns that "drive" the conversation forward, which questions are especially vital for (Boden, 1994), are certainly worth examining; "sociolinguists, in particular, have been concerned with the social patterns and organisation of language and psycholinguists have addressed the social psychological factors involved". Boden (1994) built upon Goffman (1963)'s notion of 'co-presence' as a fundamental aspect of social life, emphasising its connection to conversations and the crucial role of turn-taking in managing the flow of dialogue (Richards, 2004). In essence, co-presence renders individuals mutually accessible, and turn-taking functions like a revolving gate, orchestrating the ebb and flow of conversations (Richards, 2004). Boden (1994)'s exploration of mutual attentiveness in co-present interactions extended to her analysis of meetings, a topic of particular interest in this thesis, particularly when it comes to design. Boden (1994) viewed management meetings as not only revealing management and organisational dynamics, but also as the meaning of management

itself. They argued that the formation of a cohesive organisation emerged from localised conversations, as decisions were meticulously discussed, debated, diffused, and ultimately resolved, emphasising the significance of fine-grained, sequential organisational activities and 'local logics'[1].

The distinction between interaction and organisation is continually shaped and subject to political disputes McElhinny (1997). This distinction is not an objective, fixed entity but rather emerges from the participants' and analysts' comprehension and their familiarity with organisational 'norms' and rules, including how members interpret their roles and orientations Boden (1994) and Boden (1995). Interactions bring these understandings and knowledge into reality, which is what creates the organisation as it is (Iedema & Wodak, 1999). Iedema and Wodak (1999) highlight a shift in organisational research from a focus on abstract "macrostructures" to an understanding of micro-level interaction details. They criticise former approaches for their limitations: not understanding the importance of talk in different contexts within an organisation. Iedema and Wodak (1999) suggest that the interaction-organisation distinction is not fixed, but continually shaped by participants' understanding of organisational norms, codes, and rules. They emphasise the need to develop more in depth understandings on how these patterns of conversation gain social relevance and presence while considering the boundaries of these processes.

These patterns and conversations are impacted by what Boden (1994) describes as "membership categorisation". Membership categorisation plays a crucial role in shaping patterns of discourse and conversations within social contexts. It involves the cognitive process of "categorising" individuals into social groups based on various attributes, such as gender, age, ethnicity, and more. These categories serve as a framework that influences how people perceive and interact with one another, laying the foundation for the use of gendered language. Considering Intersectionality, this could be seen as either problematic, as it may leave little room for the nuance of multiple identities, or it could be seen as incredibly liberating as all that is brought to the conversation is what is relevant. In the context of this thesis, the impact of membership categorisation on gendered language becomes a central point of interest. By examining how individuals categorise themselves and others based on gender, and how these categories inform linguistic choices and expressions[2], the thesis aims to shed light on the intricate interplay between social categorisation and language use in the realm of gender discourse, and how this impacts design. Understanding this relationship is essential for gaining insights into the broader dynamics of gendered communication and its implications for social interactions and identity construction.

[1] Although it falls out of the scope of this thesis, it seems important that these local decisions be researched in emerging work on hybrid working.

[2] Or perhaps more accurately, how these individuals have been taught to speak based on the categories assigned to them by society, the ones teaching them to speak.

How these patterns and conversations, outside of these local emergences, affect how the project moves forwards can be seen through meeting updates, observed through Agile methodologies, which is explored further in Section 2.5, and ties in existing understandings of language and Conversational Analysis attributes (explored in Section 2.4). What this thesis focuses on, however, is how gendered language, and membership categorisation, impacts how projects move forwards, and how this may impact the products that are designed.

The insights provided by Button and Sharrock (1994, 1996) and with the reference to Bowers (1994)' concept of "the work to make the project work," it becomes evident that the management of project work extends beyond mere task completion. Projects are not just a collection of tasks; they are dynamic entities shaped by ongoing conversation and interaction among team members. Button and Sharrock's exploration highlights the importance of communication within projects. Their outline of devices for ensuring orderliness in work, such as phasing, methodical handling of tasks, measured progression, and orienting to the project as a totality, highlights the level of detail needed for project management. These devices are aguably indicitive of effective collaboration and progress, emphasising the adaptive nature of project management practices in response to contextual changes.

Building upon this understanding, the integration of Boden (1994)'s perspective on conversation in project work offers a nuanced comprehension of how projects advance. Boden (1994) states how conversation serves as the lifeblood of business, driving progress from casual water cooler chats to formal boardroom meetings. This perspective aligns seamlessly with Button and Sharrock's insights, emphasising the role of conversation and interaction in project work. Moreover, Boden's exploration of membership categorisation outlines the ways in which social dynamics shape conversation within project teams. Understanding how individuals categorise themselves and others influences communication patterns, thereby impacting project dynamics.

By looking at Hedging within project meetings, this thesis outlines an aspect of language use that may influence the trajectory of project work. Within the context of project meetings, where decisions are made and actions are determined, the occurrences of Hedging reflects a nuanced negotiation of certainty and ambiguity. While Hedging may appear as a linguistic habit or rhetorical device, its impact on project dynamics is worth consideration. By using Hedging, team members signal a level of caution or reservation, perhaps acknowledging the complexity inherent in project tasks and fostering an environment conducive to collaborative decision-making. However, the overuse or misuse of Hedging may also introduce inefficiencies or hesitancy in project execution, potentially impeding progress. Therefore, by dissecting the role of Hedging in project discourse, this thesis offers valuable insights into how language nuances may affect team interactions and project outcomes, paving

the way for more intentional and effective communication practices within project environments.

2.2 Emotional Labour

In Hochschild (2019)'s exploration of emotional labour, in "The Managed Heart," the conversations occurring beneath the surface of gendered emotional experiences are explored in depth. Hochschild (2019) explores how societal gender norms and expectations deeply influence the emotional labour performed by individuals, particularly in service industries. These conversations go beyond simply what is said, revealing the nuanced ways in which gendered emotions are managed and expressed within the workplace.

Within Hochschild (2019)'s framework, it becomes apparent that conversations about gendered emotional labour are often unspoken but incredibly impactful. Women, for instance, are often expected to exhibit empathy, warmth, and nurturing emotions, conforming to traditional gender roles. In contrast, men are encouraged to display emotional restraint and dominance. These conversations unfold internally as workers navigate the tension between authentic emotions and those demanded by societal and organisational expectations. Service employees engage in an ongoing dialogue, weighing the potential repercussions of conforming or resisting these gendered emotional norms, all while striving to meet the organisation's and customers' emotional demands. Hochschild (2019)'s work explains how these inner conversations shape and are shaped by broader gender dynamics within society. Although their work focuses on the service industry, this certainly applies to other settings such as teaching (Dörnyei & Ushioda, 2021) or technology (Rosenblat & Stark, 2016).

Hochschild (2019)'s analysis reveals that these gendered emotional labour conversations extend to "feeling rules" within the workplace, dictating how employees should feel and express emotions during interactions. Conversations among colleagues, supervisors, and employees often revolve around the appropriateness of gendered emotional displays. These conversations contribute to power dynamics (as discussed in Section 2.5.5.2) and expectations, significantly impacting gendered emotional experiences. Hochschild (2019) highlights the importance of recognising and understanding these gendered conversations as integral elements of emotional labour, shedding light on the intricate interplay between gender, emotions, and the workplace.

When considering the impact of gendered emotional labour (Hochschild, 2019), and the business of talk (Boden, 1994), it becomes clear the potential impact of organisational communication and how this could be influenced by societal gender norms. The combination of these two areas suggest that the membership categorisation process becomes deeply entwined with the regulation of emotions, as employees navigate societal expectations and organisational demands.

Serebrenik (2017) argues that software developers experience emotional labour, which has been understudied due to stereotypes of software development as an emotionless "nerdy" job. With the work of Hochschild (2019) focusing on the service industry, where women are the majority of participants, the argued lack of research due to gender in this area is one of particular relevance. Serebrenik (2017) proposes ways to identify and measure emotional labour in software developers using emotion detection in bio-metric measurements and text. Serebrenik (2017) connects to Hochschild (2019)'s research on gendered emotional labour by suggesting software development involves similar dynamics, despite being male-dominated, and emotional labour could help explain issues like burnout and turnover.

Within this framework, the ideas surrounding membership categorisation by Boden (1994) reveals that gendered conversations and emotional labour can impact the construction of workplace identities and hierarchies. Employees may engage in conversations that reinforce or challenge traditional gender roles, affecting how individuals are perceived and categorised within the organisation. The way in which emotions are managed and expressed, in accordance with gendered feeling rules, influences the categorisation process. These categorisations, in turn, may affect access to opportunities, promotion, and decision-making within the workplace. Hochschild (2019)'s insights into gendered emotional labour provide a lens through which we can better understand how conversations shape and are shaped by the membership categorisation process in organisations, highlighting the intricate interplay between gender, talk, and the dynamics of the business world.

The combined perspectives of Hochschild (2019) and Boden (1994) highlight the significance of recognising and addressing the impact of gendered emotional labour on organisational communication. Understanding how conversations about gendered emotions influence the categorisation of employees is essential for promoting inclusivity and equality within the workplace, as well as understanding the impact of these two areas on CS design. Expanding upon the work of Hochschild (2019) and their definition of **emotional labour**, this research seeks to acknowledge and further understand the interrelationship between gender, emotions, talk, and membership categorisation; and the impact that this may have on design and CS.

2.3 What is Innovation?

> I just made something unexpected.
> Something sharp, something new.
>
> Lin-Manuel Miranda - What Else Can I Do? (Encanto)

Innovation has been defined as the creation and adoption of an idea, a product, a

technology, or a program that is new to the group using it (Gupta et al., 2007). In line with this, Fagan (2004) describes innovation as being able to be focused on one of three areas: person, process or product. Innovating around these three areas could be argued to each support the other. Ideation in the context of this thesis will focus upon innovation on products and digital servives, particularly in Chapters 4 and 5.

Disruption theory outlined by Christensen et al. (2019)'s earlier work shares the demand for being disruptive when innovating and improving ideas, and the need for innovation when considering competitors (Denning, 2016). "When new technology arises, disruption theory can guide strategic choices" (Christensen et al., 2019) but it could be argued that to appreciate these opportunities, innovation must be a strategic decision for organisations. However, this strategic application is seemingly in contrast with the 'creativity' that is often used synonymously with 'innovation'.

2.3.1 Creativity vs. Ideation in Digital Innovation

Walia (2019), defines creativity as a "key ability of individuals" and that it "presumes an intentional activity (process) within a specific context or environment. Walia (2019) also defines the creative process itself as the generation of product(s), be them tangible or otherwise. They define the creative product(s) as having to be novel (original, unconventional) and appropriate (valuable, useful) to some extent, at least for the creative individual(s). In suggesting the outcome of creativity must have purpose, there is the suggestion that creativity for the sake of creativity is to be discouraged (which seems somewhat problematic).

"In addition to the many definitions of team creativity, ambiguity often surrounds the distinction between creativity and innovation" (Gilson et al., 2019). Therefore in this research, creativity will be the term used for how creative a person, and ideation will be used as the measure of this.

Disruption theory is often tied to innovation, with arguments on both sides on whether or not this should be the case. However, most agree that "unfortunately, disruption theory is in danger of becoming a victim of its own success. Despite broad dissemination, the theory's core concepts have been widely misunderstood and its basic tenets frequently misapplied" (Christensen et al., 2019). The need for purpose within creativity *in industry* is clear, otherwise misunderstanding and discouragement are sure to succeed.

The most commonly known tool for beginning the creative process is 'brainstorming', although other and more detailed techniques are discussed in Section 3.4.3. Silverstein et al. (2013) also suggest that imaginary brainstorming uncovers ideas below the subconscious by "leveraging make-believe situations to trigger subconscious creativity", setting it aside from traditional brainstorming. This practice involves taking seemingly normally statements and substituting words for those that are

seemingly random. This could be leveraged to measure creativity.

Creativity and ideation, in the digital world could be argued to be no different to that of any other field; the same processes and ideation workshop styles are able to be used in any discipline. However, it could also be argued that computer science and digital solutions are one of the fastest changing fields and therefore adaptability, creativity and the ability to innovate may be even more important when recruiting into and working within a team. "It has been shown that in software development teams there is a positive relationship between creative style and work creativity" (Fagan, 2004) and this correlation may explain why creative work environments also enable creativity, ideation and innovation to flourish.

2.4 Language

Language and conversation are one of the main forms of interaction that take place be that in person, through online calls or through written messages (Spencer, 2011). This is not to downplay the impact of other forms of interaction, such as body language, but the focus of this research will be on spoken language. This thesis focuses on spoken word, but all forms of communication can be affected by gender. Research by Kizilcec et al. (2020) has shown that women are more likely to be affected by social cues than men. Gender has also been shown to have an affect on women's sense of belonging in groups (Mooney & Becker, 2020; Widdicks et al., 2021). This Section (2.4) will focus on examining existing literature when it comes to conversation (Section 2.4.1), gendered language (Section 2.4.2) and open this discussion up to the effect this may have on women's sense of belonging in design meetings (Section 2.9).

Another component of meetings which must be carefully considered are power dynamics when it comes to the positions of participants (Hughes et al., 2016), as discussed in Section 2.5.5.2. It should also be understood that position may not simply refer to the role within the company, but any factor which may support a power imbalance; e.g. gender, race, etc. Therefore, it must be understood in smaller sample sizes that interactions and discourse may be the effect of positions within an organisation and not gender. That is not to say gender has no affect, only that it is one aspect of many.

2.4.1 Traits of Conversation and Discourse

Conversation, similar to meeting structure, has a beginning, a middle and an end. How conversation opens, takes place, and is closed is an area that is well researched (E. Stokoe, 2018). These traits must be understood before they are compared with how they are used in the context of meetings. Furthermore, although each of these traits may be affected by gender, they are the classic traits of conversation outlined by

researchers in linguistics, which can be impacted by gender, but are topics of research in their own right.

2.4.1.1 Opening conversation

Described by E. Stokoe (2018) as the beginning of "the conversational racetrack" and as a classic trait of Conversation Analysis (CA) (Liddicoat, 2011), opening conversation and discussion has an enormous impact on how a conversation is likely to unfold (E. Stokoe, 2018). It therefore follows, that this may also be the case when it comes to meetings and conversation.

For example, opening conversation with a question may seem quite forward, but is likely to invite a conversation more than a simple "hello" (Silverman, 1998). E. Stokoe (2018) states that "conversations routinely start with three pairs of reciprocal actions: greetings, identifications and "how-are-yous"." The introductions from the meetings and workshops recorded in this thesis did not raise any areas for further consideration, but the data will be presented for further research that may utilise this.

2.4.1.2 Turn taking

Turn taking is a classic trait of conversation and is often explored in CA (Sacks et al., 1974), with Boden (1994) describing it as "highly structured". This is often informal and local, but "formal meetings differ from this in that an appointed chair has the formal right and responsibility to manage the interaction among the participants" (Svennevig, 2012) which builds upon work by Boden (1994) who suggests that in formal meetings it is the chair who takes on this role (as mentioned in Section 2.5.5.1).

Sacks et al. (1978) also state that "turn-taking organisation at least partially controls the understanding of utterances". How this affects understanding should also be considered, with research suggesting that a "good" meeting or conversation is one where everybody has the same understanding of what has just been discussed (outlined further in Section 2.5.3).

Ford (2008) carried out research on academic meetings and found that the majority of turn taking was decided through non-verbal cues "such as leaning forward, gazing at the chair and raising a hand" (Svennevig, 2012). These non-verbal queues have been something considered by researchers for many years when it comes to remote meetings, but this has become more common since Covid-19 social distancing measures were introduced. For example in 2016, Paulus et al. (2016) analysed literature relating to online conversation analysis, and with regards to turn-taking, or as they term it "turn design", they relate this back to the work of Sacks et al. (1974) and whilst finding some deviations[3], find a number of similarities in the way in person and online

[3]They suggest that the classic traits of "(a) one party speaks at a time; (b) at the end of a TCU

conversation takes place.

E. Stokoe (2018) also poses that on the basis of turn taking, a party "may assess what sort, or type, or kind of person they are talking to". This suggests that not only does turn taking, of course, affect what is being said, but then how it is perceived, which may then affect how points raised in meetings are received. How this interacts with existing bias, it would follow, then could impact understanding as well as sense of belonging, which will be affected by gaps and overlaps in the conversation.

It also seems pertinent to mention Boden (1994)'s views on turn*making* as opposed to turn-*taking*; which is that turn-taking is an opportunity for turn-making through the asking of questions, for advice, clarification, etc. It is this, according to Boden (1994) which pushes the conversation forwards, similar to that of the Project Work and how this is pushed forwards, as discussed in Section 2.1.

2.4.1.3 Gaps and overlaps in turn taking

More specifically than just turn taking, how gaps and overlaps are observed in conversation can have a significant impact on the output of discussion (Liddicoat, 2011), especially when a meeting has more than two participants in, which design meetings most often do. With more people in the conversation, the opportunity for gaps is likely to decrease, whilst the cases of overlapping conversation may increase. However, it could be suggested that this simply depends on the participants, their rapport, and how likely they are to speak over one another.

Whether or not overlapping conversation is seen as a negative action, or just an inevitable trait of conversation is still debated amongst researchers. E. Stokoe (2018), for example, states that overlap can be "an example of collaboration". This thesis suggests that it is the context of the overlap that is important, which is discussed further in Chapter 7.

How gaps and overlap then affect the conversation is one that has been researched in detail, but how this then affects sense of belonging and design outputs in design meetings are areas that still require further research, a gap this thesis aims to fill.

2.4.1.4 Closing conversation

How conversation ends is the final step in much analysis of discourse (Liddicoat, 2011), and how this ties into the ending of meetings (Jay, 2009) is one that should, again, be carefully considered. It's also important to consider the work of Barnes (2007), and how often silence at the end of a conversation means that people are done talking; this should be something that is looked for in any observations and recordings.

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the next selected speaker should take a turn; (c) if a new speaker has not been selected someone can self-select, and; (d) if no one is selected or self-selected the original speaker can continue" do not happen in the same way online (Paulus et al., 2016).

At the end of a meeting, it is the hope that decisions will have been made, and how these decisions are communicated and shared between attendees, and potentially wider, is crucial. It is the hope that at the end of any conversation, be that in a design meeting or more generally, all participants leave with the same understanding of the conversation which just occurred. Any discrepancies in this, when it comes to design meetings, could lead to larger issues when it comes to product development.

2.4.2 Gender and Language

Gender and language is an established field, with many researchers using Conversation Analysis (CA) and Discourse Analysis (DA) to uncover gender differences (Benwell, 2006; Friedrich & Heise, 2019; E. Stokoe & Smithson, 2001). But as outlined above this must be considered in the context of organisational structure, meetings (Section 2.1) and emotional labour (Section 2.2) when it comes to design.

With this in mind, it is also important to consider the effect gender has on the conversations that take place when gender is not the topic of conversation, and the themes of exploration which have already been considered from Linguistics. Examples of this include, but are not limited to; Hedging and the use of gender-fair language. The main *relevant* areas of research when it comes to gender and language are as follows; sex differences in language, the construction of gender and gender identities, problem raising, Hedging, and leading and turn taking. Each of these areas in the literature, are examined below, followed by an accumulation of the existing literature regarding Gendered Language and HCI.

2.4.2.1 Sex differences in language

Speer and Stokoe (2011) state that one consideration of gender and language is "sex differences in language", which focuses on the way men and women are represented in the language itself. In meetings and interactions, an example of this could be referring to the user as "he" as an assumption, as opposed to using gender neutral pronouns such as "they". The language in question throughout this thesis is English[4], which has gender neutral pronouns that can be used as singular or refer to groups, whereas not all languages have this. Therefore, it is important to consider, for this and many

[4]In many languages, there is significantly more structure around the language itself and gender (Lindqvist et al., 2019) and some languages use masculine nouns and pronouns in reference "to both male and female referents. However, even when the authors expressly point out that masculine forms are being used to refer to both women and men, readers and listeners predominantly form mental images of men". Other research shows that when it comes to written comprehensibility, there was no difference between gender (Friedrich & Heise, 2019). Although this research takes place in English, it will be important to consider how or if gendered language effects participants for whom English is not their first language.

other reasons, if the person speaking is speaking English as a first language, as this may have an impact on their choice of words.

2.4.2.2 The construction of gender and gender identities

How gender, and varying identities, are constructed is another area that affects talk (Speer & Stokoe, 2011). This is also affected by sex differences in the language itself (Section 2.4.2.1) and whilst Speer and Stokoe (2011) recognise the use of CA as a way of understanding gender and language and the impact they have upon one another, they suggest that these parallels still hold value when it comes to categorisation and talk. How can gender identity be expressed through language without it being explicit?

2.4.2.3 Problem raising

The effect gender has on groups making decisions and what constitutes a problem are linked by Park (1996). Research looked at how these two factors impacted raising problems in a group environment, which may also be affected by gender. This could have a major impact on design meetings, e.g. if the women who are participating do not, for whatever reason, raise any problems or concerns they may see in what is being designed.

2.4.2.4 Hedging

This thesis uses the linguistic theory of Hedging to analyse the impact on how meetings are carried out and projects get done in CS. Hedging is the term referring to the linguistic style of 'Hedging' your bets with phrases such as "I think", "you know" and "sort of" (Ashcroft, 2020b; Holmes, 1986; Murphy, 2010; Tannen, 1994). Murphy (2010) states that "the use of hedges among females before a key word" is used "to avoid the appearance of playing the expert". Holmes (1990) recognises as well that the context used around Hedging also plays a large part in it's practise. For example, Holmes (1986) states that Hedging has two purposes, either to express speaker confidence e.g. "you know" or to reflect uncertainty e.g. "I think". Hedging is recognised as a "significant communicative resource for academics" (Hyland, 1996). They classify "scientific hedges" into various categories as a means of analysis, and conclude with the statement that hedges "constitute an essential element of argumentation in presenting new claims". This may be especially important to consider when asking groups to present their ideas to one another and to reflect on how these are used as either a tool to show certainty or uncertainty, as stated by Holmes (1986). More recently, Gribanova and Gaidukova (2019) also suggested

that the style of Hedging carried out can be used as a tool and is quite often done politically.

As Hedging is so subjective, and could be seen as a linguistic tool used by participants, it is difficult to tell where Hedging is used deliberately, for example to seem more approachable, or when it used due to genuine uncertainty. Furthermore, participants could have been attempting to reduce their contribution for fear of rejection or taking up space, which is a known feminist issue, and one that affects Black Women even more (Blackwell, 2020). Fraser (2010) dissects how Hedging can lead to great misinterpretation when used in the incorrect part of a sentence, for example when discussing how intelligent 'John' is, you might say "sort of, John is smart" or by placing the hedge in the wrong part of the sentence, the meaning may change entirely accidentally with "John is sort of smart" (Fraser, 2010). The potential for miscommunication is one that could be investigated in significant detail when observing innovation in a group setting to see if this hinders or helps the process. For example, could misinterpretation generate a stronger idea? Or will it simply frustrate the participants.

It is then important to reflect upon literature which focuses on Hedging and gender. Do certain genders use Hedging more or less than others? Is it used as frequently but in different ways? Do we notice it more in one gender, when we are looking for it? Or is there simply no difference? What is clear when looking at literature however, is that these differences are split categorically between men and women as the only two genders. Dixon and Foster (1997), found that Hedging was used the same number of times by both genders, contradicting what was found by Holmes (1986) who did however find that the results based on the gender of the audience of the speaker had a significant influence on "their use of epistemic sort of and confident you know." Although scholars disagree on *how* Hedging varies by gender, they all agree that is *does* vary by gender.

The position presented throughout this thesis is that Hedging can be both a tool both by leaders and team members, as well as technique to be heard, but this may have the consequence of those using it carrying out higher rates of emotional labour. This is discussed in much more detail in Chapter 7.

2.4.2.5 Leading and turn-taking

The CA trait of turn taking (discussed in Section 2.4.1.3), is also one that is affected by gender (Kitzinger, 2008). An example of this may be that, although order of talking may be seemingly random (e.g. based on going around a table), that this may sometimes be led by the men sat at the table (Ashcroft, 2020a). It is therefore important to consider the effect gender has on leadership and turn-taking. Especially as "men often achieve leadership roles regardless of past performance" (Reuben et al.,

2012).

2.5 Meeting Structure

The structure of the meeting, however, is one that may differ based on the aims of the meeting (examined in Sections 2.5.3 and 2.5.5), including the timeline of the meeting (see Section 2.5.4). This will then be examined alongside literature surrounding gender discourse and interaction (see Section 2.4.2), and how people feel they belong (see Section 2.9).

2.5.1 Design Meetings

Design has been defined in Chapter 1, but what this Section highlights is how this is carried out in practice when it comes to meeting structure. It is also important to consider how more focused Agile meetings where updates are often shared daily (Agile Alliance, 2020; Mukhopadhyay & Gupta, 2019) run as they will have different elements to more focused participatory design meetings (Balka, 1997) or innovation design meetings (Ashcroft, 2020a), as the focus is more likely to be on moving the project forwards then carrying out design. Whilst they may still have similar structure and roles, albeit with different names, the way in which the structure may affect interaction should not be discounted.

The aim of a design meeting, at the most fundamental level, is to bring people together in order to make design decisions. The way in which meetings are structured, and the people within the meeting may vary based on the purpose of the meeting (as explored in Section 2.5.3), the conversational racetrack (Section 2.5.4) and the roles within the meeting (Section 2.5.5), but the intention remains the same: to design.

Within the field of HCI there has been a huge effort to encourage women to enter the field, for this to be embedded in the curriculum (Breslin & Wadhwa, 2015), and to ensure inclusiveness in meetings that take place. Yet it cannot be assumed that equality has been achieved once there are an equal number of men and women are in the room. When design decisions are being discussed and made, it must be ensured that each voice in the room is given the same consideration. However, due to other factors many of which are outlined in this thesis, this is not always the case. But what is it about design meetings specifically that may cause additional problems compared with that of other fields?

In 2012, Détienne et al. (2012) brought together a methodology termed the Quality of Collaboration (QC) method, first used by Burkhardt et al. (2008) with regards to architectural designers, to analyse the quality of a design meeting taking place. The seven dimensions outlined include;

1. Fluidity of collaboration
2. Sustaining mutual understanding
3. Information exchanges for problem solving
4. Argumentation and reaching consensus
5. Task and time management
6. Cooperative orientation
7. Individual task orientation

Although the QC method itself is not tied to *HCI* design specifically, Détienne et al. (2012) argued that these factors allowed an in depth analysis of the impact on design meetings and surmised that collaborative design and any analysis carried out on this must involve social and pyschological research, for it is through people that collaborative design is done. Therefore, it follows that as a subsection in the field, that gender and sense of belonging must also have a bearing on the effectiveness of these meetings, with regards to these dimensions. For example, each of the dimensions outlined by Burkhardt et al. (2008), could be affected by gender and principles raised in feminist CA (E. Stokoe, 2004). To bring this back to gender-inclusive HCI design, and the meetings that happen for this to be carried out, it is clear from all areas of existing literature, that these areas are linked (Stumpf et al., 2020). But the subtleties in how discourse affects the design process and sense of belonging, have been seemingly ignored.

It should also be considered how design in CS fits into a wider software development process.

2.5.2 The Software Development Life-cycle

The Software Development Life-cycle (SDL) is a well-documented process (Leau et al., 2012; Sommerville, 2016), and whilst variations on this exist such as through Innovation Practices ("Kickbox Foundation", 2021), Agile Methodologies (Agile Alliance, 2020) and the more traditional Waterfall (Dima & Maassen, 2018); the fundamental principles supporting this remain the same. These, outlined by Sommerville (2016), are as follows;

1. "**Software Specification:** The functionality of the software and constraints on its operation must be defined."
2. "**Software Development:** The software to meet the specification must be produced."

3. "**Software Validation:** The software must be validated to ensure that it does what the customer wants."

4. "**Software Evolution:** The software must evolve to meet changing customer needs."

There, of course, exists the process before Specification even begins, where ideas or problems are brought forward to begin with (see Section 8.3.1). It could be argued that this is the true start of the "pipeline". Defined as Ideation by Adobe ("Kickbox Foundation", 2021), problem raising through other methods, or project initiation through project management; there are a number of ways in which potential new software ideas can be brought forwards. This thesis defines "design meetings" as any meeting in any of these stages which contributes to the design of the software.

When it comes to **Design** as a concept, there are many definitions for it, and how it can be applied to different contexts (as discussed in Section 1.5.4), but it can also be applied as a means of gathering data. How this is applied in practice, methodologically speaking, is one that is well researched and practised within the HCI community. The main practices that will be examined here are that of Participatory Design (Section 2.5.2.1) and a discussion surrounding other Design Methods that could be applied (Section 2.5.2.2).

2.5.2.1 Participatory Design

Spinuzzi (2005) defines Participatory Design (PD) *as* research, but also as a "as a design approach characterized by user involvement", citing earlier work by Johnson (1998), in which they state the need for a user-centered approach in all areas of design. The fourth chapter of Johnson (1998)'s book, "User-centered technology: A rhetorical theory for computers and other mundane artifacts", reflects upon the importance of putting user centered design into perspective. The context of any research is vastly important, particularly when it comes to designing for users (Johnson, 1998). Therefore PD is a way of carrying out research as well as a process that can be researched. In the context of this thesis, it is used as a means of carrying out research in the experimental Chapters held in a fabricated university setting.

Applying this in context, and as part of a methodology, requires an understanding of how human use of technology can drive interaction (Johnson, 1998), as illustrated in Figure 2.1. Johnson (1998) summarises this by stating that "these areas of study wish to make systems more usable, but they still base their research on models of the system that come from a system designer's viewpoint". Whereas true participatory design, involved allowing the users to design. This, however, relies on the knowledge of the users, which Spinuzzi (2005) states as being "highly valued", which fits into the wider understandings regarding how knowledge is formed.

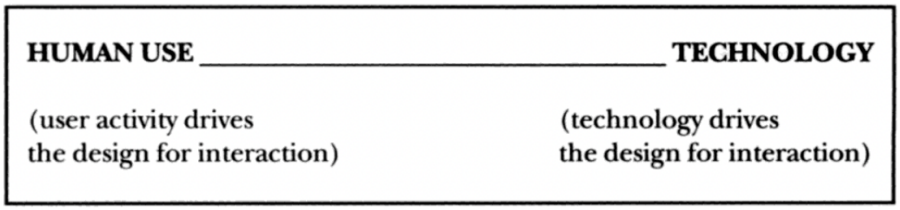

Figure 2.1: Figure taken from Johnson (1998), labelled "The Human Factors Spectrum."

> "*Participatory design's paradigm is constructivist*" [..] and therefore "*sees knowledge - making as occurring through the interaction among people, practices, and artifacts — knowledge doesn't just reside in the head.*" - Spinuzzi (2005)

The three stages outlined in participatory design, for both research and in context, are; the initial exploration of work, discovery processes and prototyping (Spinuzzi, 2005). These stages appears to have significant overlap with that of Adobe's Innovation Kickbox and the six stage process this includes ("Kickbox Foundation", 2021), suggesting that their method was built using PD as a framework, although this could simply be coincidence.

Despite the limitations PD may hold (Spinuzzi, 2005), it does offer a number of opportunities for research given that it encourages collaboration and conversation, which is the topic of study of this thesis. It also offers significant flexibility when it comes to practical implications and applications of the methodology, for example allowing between 2 and 200 participants (Muller & Kuhn, 1993).

Overall, when the topic of investigation is how participants and designers can each be involved in the design process, Participatory Design seems an appropriate method of choice, with perhaps only Co-design being it's rival.

2.5.2.2 Co-Design and Other Methods

There does of course exist, other methods of design outside PD. Co-design being the main method used throughout this thesis. Co-design "is a methodology for actively engaging a broad range of people directly involved in an issue, place or process in its design and sometimes also in its implementation" (Burkett, 2012). In this sense, it is very similar to PD.

In terms of the practical implementation of co-design, there seems to be little in the way of outlined methodology, and instead greater emphasis given to the philosophy behind it; i.e. that it involves collaboration. An examples of its implementation is

the running of "design sessions" as carried out by Harrington and Dillahunt (2021), which was applied in a similar way in Chapters 4, 5 and 6.

When it comes to co-design and diversity, there is an acknowledgement that this needs to be addressed, and research ha started to be presented in this area (Harrington & Dillahunt, 2021). However, is co-design unique in this need? It could be argued, that all design principles and methodologies need to be readdressed with diversity in mind, as they all present many of the same issues feminist methodologies criticise them for.

> "*Researchers acknowledge the necessity to re-imagine co-design methods to be more equitable.*" - Harrington and Dillahunt (2021), citing Harrington et al. (2019) and Walsh and Wronsky (2019)

Regardless of how design takes place be it through Participatory Design, Co-design or any other method, there is the need for acknowledgement in the impact gender can have on the process. This can be achieved through applying Feminist Methodologies.

2.5.2.3 Researching Gender in Innovation and Design

As an example of design, Participatory Design (PD) has been designed as a methodology and can be used as an element of innovation to allow design to occur involving all stakeholders (Hansen et al., 2019). The importance of involving as diverse a range of stakeholders as eventual product consumers cannot be understated. For example in 2015, an article was published by the BBC after the launch of the Apple Watch voicing concerns of consumers with tattoos that features such as heart rate censor did not function correctly, labelled as "TattooGate' (BBC, 2015). The BBC also stated that "it can also happen to people with dark pigmentation or black skin". How a product as highly anticipated as the Apple Watch made it to market with such discrimination built into it is highly suggestive of a lack of diversity in its design. The application of Intersectional Methodologies is not a new concept and is embedded in Black Feminist Theories which go back many years Alexander-Floyd (2012) and Vincent (2018), and continue to be applied in recent work, with Harrington and Dillahunt (2021) considering Afrofuturism as it relates to co-design, similar to PD, practices in 2021.

Continuing with the example of PD, this is segmented into three stages; an initial exploration of the work, a discovery process and prototyping (Spinuzzi, 2005). In each stage the should be involved, and continue to be so as the stages are used interactively. The second stage, the discovery process "is where researchers and users interact most heavily, and it also typically involves group interactions". There are many reasons why diversity may not be successfully considered in this; for example, the range of users gathered may be diverse, but the designers may not be; this may silence the

voices of the participants. There may be an appropriate range of participants and designers when it comes to gender, race etc., but then how do their interactions take place, are these allowing for equity? Another example of design within PD is that of using Personas, however event this should not rely solely on treating gender as a binary, in fact; "from a gender perspective, it is important that gender does not stand alone, but is conjoined with other structural categories" (Marsden et al., 2017).

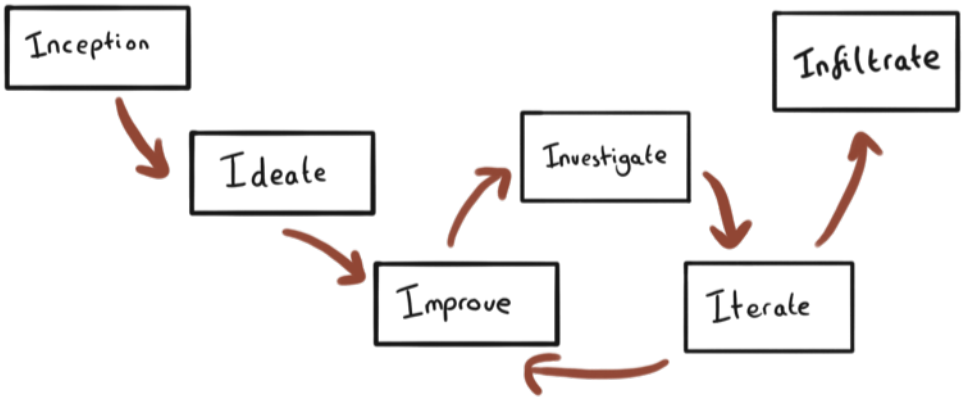

Figure 2.2: The six stages of innovation with the labels taken from Adobe's KickBox ("Kickbox Foundation", 2021).

The open source innovation guidelines by Adobe, called "KickBox" ("Kickbox Foundation", 2021) is used by many companies as a means of innovation which leads to design. KickBox follows a six step process (as can be seen in Figure 2.2); inception, ideate, improve, investigate, iterate and infiltrate ("Kickbox Foundation", 2021). These stages each allow for contributions from team members to create and improve ideas until the final infiltrate where these are supposed to feed back into an organisation's processes or plans for future work. This framework, incredibly similarly to PD, once again relies upon the sharing and voicing of ideas and recommendations from everyone involved, and therefore once again raises the issue of if half the participants are not being heard due to their gender, then the innovation output will be nowhere near as valuable to the organisation.

The inception stage focuses on the participants, or innovators and encourages them to share their motivations with one another ("Kickbox Foundation", 2021). The idea of motivating participants for change may be interesting to research further, especially to see if gender plays any part in what motivates participants to partake in innovation. The second stage, ideation is perhaps the most creative stage as this is where ideas are generated and formed. The concept of there being no "bad ideas" is one that Adobe encourage in this level with a "Bad Ideas" notebook ("Kickbox Foundation", 2021).

This is possibly one of the encouragements from the programme which does allow for equal involvement from all genders. For example, the fear of failure and gender has been well established for some time, and has often been linked to women's reasons for leaving the technology industry (Holtzblatt & Marsden, 2018a). Therefore, especially when innovation is happening within HCI and Computer Science, it is vital that any genders do not feel excluded or feel the pressure to come up with "good" ideas; i.e. there are no bad ideas ("Kickbox Foundation", 2021).

The next three stages of the innovation cycle are to improve and investigate, and to iterate through these two stages ("Kickbox Foundation", 2021). This also aligns with the process of "collaborative reflection" as a facet of PD outlined by Hansen et al. (2019). By continually reflecting and improving, as well as involving all potential stakeholders, a stronger product will be achieved and it is vital that every voice is herd in this process, otherwise it could be argued that improvement will be limited. The final stage of the innovation box is infiltration ("Kickbox Foundation", 2021) and if done incorrectly could mean that the time and effort spent in the previous five stages never progresses through the institutional procedures, the effect of this being the design never reaches production. Each of these stages is vital to enable innovation in an organisation, as well as making it though with a coherent set of designs and artefacts; and an initial exploration has shown that diversity will improve the success of this.

The message that diversity is key in any form of design and therefore HCI is consistent. The range of variables which can affect design, make it incredibly difficult to uncover the cause of its failings, and it could also be argued make it even more difficult to hold organisations accountable when arranging a design process. However, the one thing that can be taken from the uncertainty, is that the potential for failure is higher, when diversity is not even considered.

2.5.3 Purpose and agenda

Productive meetings, regardless of their intention being design or otherwise, must have a purpose or goal (Svennevig, 2012), supported by Schwartzman (1989) who describes meetings as;

> "*a communicative event involving three or more people who agree to assemble for a purpose ostensibly related to the functioning of an organisation or a group, for example, to exchange ideas or opinions, to solve a problem, to make a decision or negotiate an agreement, to develop policy and procedures, to formulate recommendations, and so forth.*"

How this purpose is met is often through an agenda; which may be simply broad (e.g. "design x") or much more structured and detailed. When an agenda item or topic

is concluded, Barnes (2007) suggests that it is silence which suggests a conclusion has been reached, not verbal confirmation. Regardless, the structure of a meeting is one pre-established and similar to all good stories; with a beginning (an opening which outlines the objectives), a middle (in which discussion takes place or decisions are made) and an end (everyone leaves with a common understanding), as discussed in Section 2.4.1.4.

Jay (2009) also states that there are other considerations when it comes to types of meetings that should be raised; frequency, composition (who is in the meeting and their dynamics), motivation (and how this differs between attendees), and the decision process. The decision process is perhaps one that should be most strongly considered, especially when it comes to looking at group dynamics. Are decisions made by a general consensus, a majority vote or the chair after they have listened to the discussion (Jay, 2009)? All of this should be agreed before the meeting, but opinions on this may of course differ, once the meeting is in progress.

2.5.4 A beginning, a middle, and an end

As mentioned above, like all good stories, a meeting should have a strong beginning, a productive middle, and a conclusive end (Jay, 2009). This is reminiscent of how conversation also takes place (outlined in Section 2.4.1) The beginning of the meeting should outline the objectives and aims, and it is most common for this to be done by the chair (Svennevig, 2012). The middle should comprise of a list of agenda items, which can typically fall into four categories, outlined below (Jay, 2009). And the end should be where the output of the meeting is summarised, so all attendees leave with the same understanding. However, what past literature can agree on is that the structure of meetings, however variable, does affect the output. Therefore, how they take place is important; and most frequently, how these interactions take place, is through discourse and interaction.

The four categories into which agenda item can fall into include; "informative-digestive", "constructive-originative", "executive responsibilities", and"legislative framework" (Jay, 2009). But what is perhaps of more interest in the context of this thesis is the structure of the discussion, which Jay (2017) (originally published 1976) suggests is too nuanced to outline for all cases;

> "*It may seem that there is no right way or wrong way to structure a committee meeting discussion. A subject is raised, people say what they think, and finally a decision is reached, or the discussion is terminated. There is some truth in this. Moreover, it would be a mistake to try and tie every discussion of every item down to a single immutable format. Nevertheless, there is a logical order to a group discussion, and while there*

> *can be reasons for not following it, there is no justification for not being aware of it.*" - Jay (2017)

2.5.5 Roles

When it comes to attendees of a meeting, their roles depend purely on context; and the literature outlined below states that regardless of purpose those in attendance of a meeting should be active participants, not merely observers.

When it comes specifically to design, the standard roles of those in attendance may vary according to the make up of the team and their project management structure. This thesis will reflect on design meetings as a whole, but it is understood that this may leave some gaps when it comes to specifics.

2.5.5.1 The chair and their responsibility

Meetings most often have a chair; the person who's role is to keep the meeting on topic and on track to complete its purpose (Svennevig, 2012).

> "*The most distinguishing feature of meeting interaction is the presence of a chair that is charged with managing the access to the floor and assuring the topical progression of the meeting according to the agenda. These tasks provide the chair with special rights and obligations in controlling the contributions of the participants. He or she has a dominating and privileged position in being authorized to encourage contributions and actions that are considered constructive to the goals of the meeting and sanction behaviour that is considered illegitimate or counter-productive. Also, in formulating decisions and conclusions the chair acquires a strategic position in the meeting.*" - Svennevig (2012)

The power that this position holds cannot be discounted, especially when it comes to diversity, and particularly when it comes to turn-taking (see Section 2.4.1.2). If the chair is there as a facilitator, their views may be discounted. If they are there as a participant, they may inadvertently dominate the meeting. The effect that they have on other participants must also be fully understood, for example, are they allowing equal opportunity to speak and express views to all participants?

Unconscious bias (Easterly & Ricard, 2011) is something that must also be considered when it comes to chairing meetings. For example, if the chair of a meeting believes themselves to be unbiased, they may not actively ensure that everyone has equal opportunity, particularly online (Dhawan et al., 2021). However, they may still have bias and prejudice they are unaware of, only by becoming aware of this would they be able to actually provide equal opportunity for all participants (Williamson &

Foley, 2018). Although unconscious bias training' is sometimes seen as an exercise to fill a quota, it can also be quite effective when carried out properly; as The Harvard Business Review states in their article "Don't give up on unconscious bias training — make it better" (Emerson, 2017).

2.5.5.2 Roles and power

In an ideal world, the only roles that people took on in meetings would be those appropriate to their position within the organisation. However, these roles are likely to be affected by gender bias (e.g. through bias in the recruitment processes caused by perceptions of who would be a best "fit" (Heilman et al., 2015)). Also, once in the meeting room or digital spaces, power will have an impact on interactions (Mullany, 2004) and therefore how the meetings take place.

DiTomaso et al. (2007) state the need "to link discussions of workforce diversity to the structural relationships among groups within the society." They discuss the impact that power can have at both the macro and micro level. While citing research by Sidanius and Pratto (2001) regarding "social dominance orientations," which "constructs a theory of social relations based on dominance and subordination," acknowledge that roles within an organization will play a part in power dynamics. Additionally, society will have an impact on the relationships between those in the room.

The commercial books by comedian Sara Pascoe, "Sex, Power, Money" and "Animal" both offer insights into how biological sex can affect interactions, for example how hormone production alters when people see one another (Pascoe, 2016, 2019). The argument of nature vs nurture is one that is brought up many times when I have been presenting research throughout my PhD[5], and whilst some behaviours may be due to biological sex, the idea that as a society we are still fully dependent on these is incredibly outdated. Power dynamics are a product of society, and whilst at some point, they may have been a product of biological sex, this is no longer the case (Rippon, 2019).

Considerations around race and intersectionality (see Section 1.5.3) and the impact these, along with other characteristics, will have on power and interactions in meetings must also be examined, so as not to assume that gender is the only characteristic of note, despite it being the focus of the research.

Societal power dynamics will have an impact on the roles people are given in businesses and meetings (Sidanius & Pratto, 2001), as well as the positions that people are given within an organisation (Heilman et al., 2015; Reuben et al., 2012), and this will affect interactions in meetings. Boden (1994) describes these attributes

[5]It could be argued that this argument is mainly used to avoid accountability for behaviour and actions.

as "membership categorisation" and states that any conversation brings the relevant categories forwards, such as gender, race, role etc., and the way that this is done is through talk and language.

Finally, the position of power held by the researchers should also be considered. This should be done through intersectional reflexivity, as discussed in Section 3.5.1.

2.6 Research during the COVID-19 Pandemic

The first six months of this PhD were carried out before March 2020, and the aim of the research prior to this was to watch people interact in groups. As the length of the pandemic was unclear at this point time was taken to carry out a very thorough literature review, before it was accepted that the studies would have to continue online. Therefore it is vital to understand existing literature surrounding online workshops.

Existing literature on online focus groups (OFGs) explores how these can be run and how they do hold benefits that in person workshops do not (Oringderff, 2004). In 2001, a paper titles such as 'designing and conducting virtual focus groups' suggests that moving to OFGs is the way that things are moving as technology advances (Sweet, 2001) and this prediction has been solidified further by the pandemic. Not only is it now a sometimes more convenient option, but for a significant portion of this research, it has become the only option.

In the early stages of OFGs being used, the focus was more on textual forums, surveys and one on one interviews as the most appropriate way of using the online space for qualitative research (O'Connor & Madge, 2003) and there seems to be little reference to large spoken forums. However, as OFGs become more popular there seems to be more literature around "synchronous online chat and group dynamics" (F. E. Fox et al., 2007).

Oringderff (2004) explores the idea of synchronous and asynchronous groups describing asynchronous groups as when "participants log in and answer discussion topics on their own time, through listservs, mailing lists or discussion groups." They also list the benefits has including "the ability to overcome global time differences, time allowances for participants with variable typing skills, and more time for participants to focus and reflect on responses" (Oringderff, 2004). Synchronous focus groups, on the other hand, are described as being more "similar to traditional face-to-face focus groups as they feature real time interaction between the moderator and participants, but use chatrooms or focus group software packages instead of real classrooms" (Oringderff, 2004).

The main benefit when it comes to this research of running synchronous groups is that "the initial reactions and opinions of participants are more spontaneous in real-time interaction, which may give researchers more reliable results" (Oringderff,

2004) which is more appropriate for this research as it is the interactions between the participants which are being observed as the main form of data collection.

But this is also something that may be disadvantaged by being online, with (Oringderff, 2004) stating there are "several limitations exist in the area of group dynamics." One of which particularly pertains to classic CA traits, stating that the "lack of nonverbal cues and the absence of vocal cues (e.g., inflection and intonation) can have a negative effect, as offense may be taken more easily and meanings misconstrued." (Oringderff, 2004). This potential for miscommunication must carefully be considered, especially when researching gender and conversation, as this may lead to participants feeling uncomfortable which would be an important ethical concern.

Post-pandemic, there are now more and more papers emerging with how to move research online, one of which poses that online group interviews are significantly more appropriate to run online that online focus groups suggesting that they feel less intrusive and more convenient (Dodds & Hess, 2020). However, this again raises the question on how interactions between group members, the focus of this research, will be effected by moving to an online format.

Kennedy et al. (2021) found when running workshops after Covid that "the online environment did not necessarily limit the capacity for interactive methods", as they ran a study where the participants used virtual "click and drag" tools to rank activity cards and were able to provide rich feedback after exposure to, and consideration of, each of the activity cards." However, online tools such as this did not get used in the workshop ran in Chapter 6, as there were only two participants due to last minute withdrawals.

The importance of researching and understanding the dynamics of online group interactions, given the increase of remote work in the post-pandemic world has been highlighted in more recent literature (Blanchard, 2021). Blanchard (2021) call on social psychologists and organisational researchers to apply their expertise to help guide individuals, managers, and organisations toward more positive outcomes in the context of remote work and virtual group interactions. Research by Kennedy et al. (2021) outlines the need for iterative planning for the running of online workshops, which was certainly found to be true due to the technical issues found in both Chapters 6 and 7.

Furthermore, "Zoom fatigue" is becoming a more recognised problem since the Covid-19 pandemic (Kennedy et al., 2021), with Kennedy et al. (2021) recommending the breaking up of activities to overcome this "e.g., pre-workshop surveys, different styles of engagement including online polls, virtual brainstorming", which was applied in Chapter 6 with a combination of individual ideation and group discussion.

Although Kennedy et al. (2021) state that "it seems unlikely that online co-design will replace all face-to-face co-design in the future", many businesses have kept some

element of hybrid working since the pandemic (B. Wang et al., 2021)[6], with this being evident in Chapter 7 where often team members joined from either home or the office.

2.7 Diversity in Digital Innovation

> Sometimes the right thing for one person is the wrong thing for someone else.
> So... Good luck figuring that out.
>
> Stephanie Meyer - Twilight

Fagan (2004)'s research has proposed that "the innovative cognitive style described by Kirton's Adaptation-Innovation (A-I) theory describes the "style of thinking" that will be characteristic" of development teams. A-I theory draws correlations between an individual's behaviours and the outcomes of the organisation to an individual's cognitive style preferences. Therefore, this poses the question, do cognitive styles within a group correlate with a group's diversity? And are these cognitive styles affected by gender?

As was shown with the separate gender groups in my previous research, men and women approach tasks differently (Ashcroft, 2018), although this research was limited by the number of participants. This difference of approach and opinion has previously been shown to create a stronger product. Research shows that companies in the top 25th percentile for gender diversity on their executive teams were 15% more likely to experience above-average profits ("More Evidence That Company Diversity Leads To Better Profits", 2019)[7].

In terms of Innovation, the process of generating meaningful change often beginning with ideation (as defined in Section 2.3), and increased diversity improving the process could also be said to be true, but to what extent? Diversity has been proven to increase a company's potential earnings ("More Evidence That Company Diversity Leads To Better Profits", 2019) and so has innovation (AWS, 2019). Therefore, perhaps it can be assumed that diversity and innovation could work hand in hand to improve digital services and the working practices of teams. Although, as previously stated, profit should not be motivation for diversity, but an understanding that all humans deserve equal opportunity, it can be a persuasive tool in conversation

[6]There was also found to be economic impact due to this (Battisti et al., 2022), which is note strictly relevant to this work but interesting, as there was much discussion online during this time about how previously marginalised group's requests such as remote working were taken seriously when it was made essential to the economy.

[7]Although it problematic to hold profits and the bottom line, as justification for diversity (Fanon, 1952), it does show the"value" it can have.

with those already in positions of power.

2.8 Gender and Diversity in Group Settings

Over twenty years ago, research proved that "both men and women working in gender balanced groups have higher levels of job satisfaction than those who work in homogeneous groups containing mostly men or mostly women" (Fields & Blum, 1997). This existing research suggests that it is not only arguably 'fairer' to have a gender balanced work force, but this can lead to higher levels of job satisfaction and to increase the sense of belonging and willingness of employees which is beneficial to both themselves and the employer.

However, the dynamics that men and women have within a group setting may not allow for true equity. For example, Figure 2.3 shows an adaptation of "how different communication patterns may lead to inaccurate perceptions of female knowledge" (Franklin, 2013).

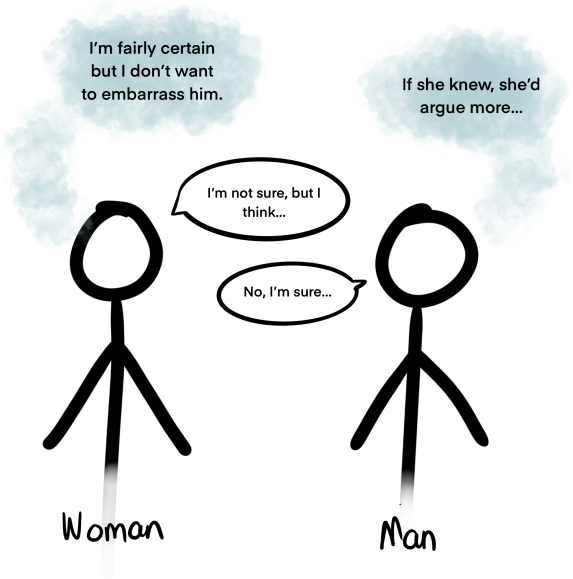

Figure 2.3: Illustration of communication patterns adapted from Franklin (2013).

Although unaware of it at the time, the illustration by Franklin (2013), Figure 2.3, was my first exposure to "Hedging" (see Section 2.4.2.4). But the way in which men and women interacted in group settings is one that resonated with me, and the work I had already begun to look into regarding language (see Section 2.4). Furthermore, as it was clear that most innovation and design decisions happened in group settings,

it was clear that this, along with the structure of meetings (see Section 2.5), should become the focus of the research[8].

2.9 Sense of Belonging

The implications of the relationships between gender, language and design go beyond the products which are designed, and have the potential to impact the emotional regulation of those involved in the process (as outlined in Section 2.2). Research carried out by Mooney and Becker (2020) looked at how a student's sense of belonging varied based on their gender and other variables (e.g. sexual orientation, religion, etc.). They found that women who identified as part of another minority group had a lower sense of belonging, whereas women who didn't identify with another group had a similar sense of belonging to the men in the study. This could suggest that gender on its own is not a factor, but has an impact when combined with another. This ties into what is known about Intersectionality, a product of Black Feminist Theory (De Hertogh et al., 2019). However the impact of Intersectionality on a sense of belonging, has not yet seemingly been tied, by literature, into the any potential impact on design - a gap this thesis aims to fill. Furthermore, within the field of CS, research has shown that to improve women's sense of belonging overall, there is a need for a collective response (Widdicks et al., 2021). Incorporating projects with a focus on social good within the computing curriculum can create a more inclusive environment that attracts and retains female students (Widdicks et al., 2021). By highlighting the positive impact of technology in solving real-world problems, initiatives can inspire and empower more girls to pursue computing as a means to drive positive change in society, and feel like they belong in these teams doing so.

Further research does exist in other STEM subjects, such as Mathematics (Good et al., 2012). Good et al. (2012) found a correlation between sense of belonging and self perceived limited ability, see the below quotations, which strongly ties into Dweck's work on fixed and growth mindsets (Dweck, 2017; Haimovitz & Dweck, 2017).

> "*Students who believe that their colleagues view math ability as acquirable are able to maintain a high sense of belonging, which in turn reduces the power of perceived stereotypes to impair females' desire to pursue math and their achievement in math.*" [...] "*Although the studies in this article focus specifically on females' aspirations and achievement in math, the issues addressed easily apply to members of any group who face messages of limited ability in an achievement domain.*" - Good et al. (2012)

[8]How this can be applied online, to remote meetings and online groups, and the literature surrounding this can be found split over, Section 2.9 and Chapter 6, as how this translates into online meetings was only brought into this thesis and research as a necessity of the Covid-19 pandemic.

The idea of "a sense of belonging" further resonates with previous work done by Olson and Olson (2000) which highlights the importance of common ground and the readiness of collaboration with regards to social interaction and technology as a tool for this. In conjunction with other research regarding online collaboration, especially since the Covid-19 pandemic (Dhawan et al., 2021), literature regarding the sense of belonging of participants, and how being remote and online can affect this should be considered.

Although this paper does not pose any new theories on Sense of Belonging itself, it is important to consider the impact that this may have on conversation and design, as well as those in the design meetings and those which will use the software or products when they are built.

2.10 Research Questions

What is addressed throughout this thesis are potential inequalities in interaction, power and knowledge produced through 'taken for granted', 'normal' features of organisational structure and practice, and conversation; such as everyday organisational meetings as well as meetings specific to design.

The potential overlaps between *meeting structure and language*, *language and gender*, and *gender and sense of belonging*, must be examined alongside methodologies to uncover how any potential problems, once uncovered, may begin to be resolved.

Furthermore, aligned with feminist methodology practices, any research and literature cannot be simply assumed to have been carried out objectively or fairly (Sprague, 2016). Despite many arguing that feminist methodologies are simply good research practice, any literature examined in this paper may have used previously assumed patriarchal knowledge to strengthen their research. Therefore a closer examination of this *in practice* would be prudent regardless to reaffirm all that has been taken to be true.

Considering this, the following research questions were outlined, and led the direction of each of the studies contained within this thesis.

- **RQ1 - What influence does gendered language have in the production of project meeting outcomes?**
  - **RQ1.1** - To what extent does gendered language and behaviour impact the accomplishment?
- **RQ2 - What methods are the most insightful for uncovering factors that impact how design meetings are accomplished?**

  - **RQ2.1** - How can these methods be informed by existing feminist methodologies?

- **RQ3 - What concepts prove most useful in the examination of gendered interactions in project meetings?**
  - **RQ3.1** - How are these concepts affected by gender?
  - **RQ3.2** - How is design impacted by concepts such as Hedging, interruptions, emotional labour and project work?
- **RQ4 - What are the implications for design of this research?**
  - **RQ4.1** - How does this impact our understanding of success or failure in design?

Chapter 3

Methodology: To assess the equation of you...

Elements of this Chapter have been published in BCS HCI 2023 (Ashcroft, 2023) and IADIS 2022 (Ashcroft, 2022a), but amendments have been made in this thesis to expand upon areas and add more clarification.

The research questions for this thesis (outlined in Section 1.4) rely on an in-depth understanding of how conversation takes place, the perceptions of these conversations, and the impact they have on the overall process and products being created.

Throughout this chapter, which outlines relevant methodological practices such as measuring diversity, innovation methods, design techniques, and analytical methods, particularly those involving Content Analysis (CA) and Thematic Analysis, our emphasis has been on the presentation of data to address the research questions outlined in Chapter 1. However, in order to fully understand how these can be answered, various studies were run throughout the duration of this thesis in a somewhat Agile Methodological approach (see Section 3.3), with each study leading onto the next, and being adapted based on the needs and leanings from the previous study. Therefore a methodology for the collection and analysis of data will be presented in each chapter as appropriate.

Overall the methodology for this research followed a fairly linear timeline, with the development of more detailed research questions and topics emerging throughout.

1. Firstly, a pilot study was conducted to identify the most influential aspects of innovation workshops on decision making (Chapter 4).
    - Recordings were attempted but deemed unusable due to simultaneous running of two groups (the audio was not able to be transcribed).

- The focus shifted to analysing conversations, identified as the most captivating data source.
- Analysis was restricted to field notes written during observations, which were not comprehensive due to simultaneous groups running.

2. Building on the pilot study, a student innovation workshop centered around the theme of 'Academic Outcomes' was conducted (Chapter 5). The analysis brought forth gendered conversation traits.
   - Thematic Conversation Analysis was performed using the thematic analysis, and traits from CA as existing themes.
   - Several themes were identified, in addition to those brought in from CA, and these were carried forward into subsequent studies.
   - Categorisation was carried out and a comparison was done around gender.
   - Hedging occurrences in the transcripts were analysed using a Mann-Whitney U Test.
3. Due to Covid-19, all workshops and data collection had to transition online because of social distancing measures. Consequently, another pilot study was conducted using online video conferencing software (Chapter 6). This study also facilitated an evaluation of the adapted methodology for online implementation.
   - Existing themes from previous studies and CA were used in another thematic conversation analysis.
   - These themes were carried forward into the subsequent study.
4. However, after completing this online pilot, it became apparent that understanding the impact of gendered language within CS required observation in an industry context, in order to uncover if this was still the case when it was part of a more extensive process. Therefore, meetings of a software development company were observed as a case study (Chapter 7).
   - Thematic conversation analysis was once again conducted, revealing additional themes.
   - A further Mann-Whitney U Test was carried out on the occurrences of Hedging to determine any significant difference.

3.1 Research Approach: Feminist Methodologies

As a woman researching gender in the field of HCI and Computer Science it's easy to consider gender as a binary is that the only experience that has been held.

Discrimination has been faced because of my gender, and therefore it would be very easy to only consider gender in this way when carrying out research. To perpetuate research that supports gender as a binary would be wrong, and again add to the difficulties many face due to not identifying as cis-gender; "someone whose gender is congruent with that assigned at birth" (Speil et al., 2019). However, as the aim of most research is to fill in the gaps of previous research, it must be considered what from past research can be taken to be true. Could it be that only recently has research started to consider gender fluidity, especially within HCI? This ties into what we know about feminist methodologies.

Feminist methodologies are built on the argument that the traditional "'rules' of research have embedded within them an unconscious patriarchal bias" (O'Leary, 2017). One of the main concerns around this is that this goes undiscussed and any prior knowledge, assumed as general knowledge, may have come from a place of male bias, and may not have considered gender fluidity. To overcome this, any research carried out must not rely on any previous research when results are analysed. Davis (2019) argues that diversity is "not only essential as a goal of intersectional feminism, but also as a means of continuing success for digital movements." It has been suggested that by not working towards feminist and intersectional perspectives within methodologies, then scholars are nothing but "passive participants" in what is otherwise an actively engaged field (De Hertogh et al., 2019).

Rode's main arguments for applying feminist theories to HCI include that gender balanced studies have not been carried out in past HCI research, and secondly "there are individuals who have a hostile attitude towards the topic altogether and believe women are lesser creatures" (Rode, 2011a). It is important when carrying out the study, that both the male and female participants are treated as equal and that stereotypes are avoided; for example, that the women will be unable to carry out the task as well as the men, or on the opposite side, assume that the men will understand the task more than the women.

However, feminist methodologies do face criticism as outlined by O'Leary (2017) in that carrying out unbiased research is not a value of feminist research, but of good research. However, other feminist theorists are sceptical of the idea of bias and the idea that 'a view from nowhere' is possible (Rolin, 2006), given that context will often impair objectivity (Toole, 2022). All this considered, if feminist research simply acknowledges past prejudice and uncovers unthought-of failings on previous research, then surely this makes it worthwhile. "Quantitative scholars who want to be responsive to feminist and other critiques of positivism have little to go on" (Sprague, 2016) meaning that to carry out a feminist methodology, is to set an example for academics. Feminism in any study must be ingrained into every aspect of the study, without causing bias towards participants. Therefore, to carry out a feminist study, not only must all female participants must be allowed the same opportunities, given

the same information and treated in every way the same as the male participants to ensure that this limits the affects on the results, but the same equal treatment must be given to any transgender or non-binary participants. As argued by O'Leary (2017), feminist methodology is almost synonymous with good qualitative research practices but that there is value in engaging with literature on feminist methodologies, to expose the cultural bias embedded in research practices.

Examples of how feminist methodologies can be applied to HCI are available in many publications, with many conferences now hosting entire sessions including feminist research (e.g. "HCI Confronting Issues of Race, Genders, Feminisms, Reproductive Health" at CHI 2021 (CHI2021, 2021)), but how they each apply these is of course adapted to the research in question. One such example of this is the application of Feminist Content Analysis in a recent 2021 paper by Spors et al. (2021), regarding the sector of "Mental-Health-focused Self-Care Apps". By adding a feminist lens to the already established Content Analysis method, they enabled a critical analysis and understanding of the applications they were looking at that may otherwise have been missed, had standard Content Analysis been carried out. Referencing Leavy and Harris (2018), Spors et al. (2021) use "the politics of representation" to apply feminist frameworks such as power structures to their analysis, and in doing so are truly able to use Intersectional methodologies in their research too, citing the work of Alexander-Floyd (2012) (the importance of which is discussed in Section 2.5.2.3).

When considering the effect, gender plays on HCI, it is important to reflect upon research that has already been done, and which groups this has considered. Reflecting upon Intersectional Feminism and the methodologies these can invoke, it must be understood that true Intersectionality is a product of Black Feminist Theory (Alexander-Floyd, 2012), but is often carelessly used synonymously with the linguistic definition of the simple cross over of two attributes or traits. Furthermore, how much of this research involves gender identities other that cis-gender? For example, if "the ACM Conference on Human Factors in Computing Systems (CHI)" (ACM, n.d.) is taken into consideration; a search of the ACM's "Full-Text Collection" on their own site, reveals that out of 592,800 records, 2,784 contain the word "gender" anywhere in their text (ACM, n.d.). This simple search shows that gender is being acknowledged in the HCI community. However, as Schlesinger et al. (2017) introduce intersectionality as a framework for research, recognising it as the overlap of attributes making up an individual's identity, they have carried out further research into the intersectionality of HCI research. Their research brought together a keyword set "included terms that describe gender, ethnicity, race, sexuality or class" and found that only 1% of all CHI publications included these keywords, showing that work has yet to be done.

When it comes to **Feminist Epistemology**, "there has been debate between feminists about whether there can be feminist epistemology" Barbour (2018), but if

epistemology refers to the theory of knowledge and understanding, and the subjects of the research 'have gender', then the argument from feminists that "gender and individual identity are significant in the process of becoming a subject and a knower" (Barbour, 2018; Flax, 1993), then surely they must be relevant in social research. However when it comes to applying feminist epistemologies in CS, where often logic and structure are seen as important values, this may clash with the more general understanding of how knowledge is formed. As stated by Hancox-Li and Kumar (2021), "feminist epistemology has long taken a critical stance towards fully formalized systems, instead emphasizing the interactive nature of knowledge creation and the importance of exploring multiple possible meanings". This may be even more important to consider where gendered language is the topic of research, as this research quickly became, as the misunderstanding of language, or its interpretation is key to understanding the effect of gendered language in CS.

Therefore, as stated by Longino (1994), there should be a distinction made between feminist epistemology as a practice, or as content;

> "*If, as I suggested, we understand feminist epistemology as practice rather than content, it may well be appropriate to take issue with some analysis produced by the practice, but it is hard to see how one could be for or against feminist epistemology except insofar as one is for or against feminism.*" - Longino (1994)

This research, it is hoped, is distinctly feminist in that it aims to break down existing assumptions regarding gender, and uses existing **Feminist Methodologies** (see Section 3.1) to uncover the effect of gendered language on CS. Therefore, in line with the above quote from Longino (1994), the contribution to knowledge that this research makes should be feminist, as it is for feminism. Recent work on feminist epistemologies (e.g. Barbour (2018)) makes much reference to the earlier work of Belenky et al. (1986) and their offering of "five epistemological strategies", despite their acknowledgement that these positions "cannot adequately capture the complexities and uniqueness of an individual woman's thought and life" (Belenky et al., 1986);

1. "***Silence*** — *woman experiences herself as mindless and voiceless, dependent on external authority.*
2. ***Received knowledge*** — *woman conceives of herself as capable of receiving and possibly reproducing knowledge from authority, but not of creating her own.*
3. ***Subjective knowledge*** — *woman conceives of truth and knowledge as personal, private and subjectively known or intuitive.*

4. ***Procedural knowledge*** *— woman is learning and applying outside procedures for accessing and communicating knowledge.*
5. ***Constructed knowledge*** *— woman views all knowledge as contextual and experiences herself as creator of knowledge, valuing both her own and objective strategies for knowing.*"

- Barbour (2018) surmising Belenky et al. (1986)

These five strategies could be argued as incredibly problematic, in that they are trying to define "woman"'s experience, before any research has even been carried out. This in and of itself seems to be misaligned with most feminist epistemologies and methodologies. A more inclusive and open definition of feminist epistemology will therefore be adopted in this research in line with Hancox-Li and Kumar (2021); "instead of aiming for one correct, objective view of things, they argue that we should instead accept that knowers are social beings, who bring perspectives to each issue that are conditioned by their social experiences."

> "*Feminist epistemology also encourages a more interactive way of how knowledge is created, considering the object of knowledge not just as a passive object with static properties, but also as an agent that can enter in conversation with the knower.*" - Hancox-Li and Kumar (2021)

This brings us back to the comparison of facts and opinions, and how these are derived from knowledge. Pernecky (2016) strongly states that "to claim the objectivity of social facts is to attract the critique of anti-realist and anti-objectivists, strong social constructionists, deconstructionists, and many a critical theorist". But there seems to be a consensus that data collection is the way of deriving these "social facts". The main issues raised with data collection methods, are those of reflexivity and creativity. Hester and Francis (1994) acknowledge the importance of recognising reflexivity - how the researcher effects how participants respond to questions or behave in studies. This is an issue for anyone carrying out social research, which is the majority of this thesis is. The concern raised from this is whether the responses from participants were truly an honest reflection of how they behave, feel and think, or did they say what they thought the researcher wanted to hear? In addition to the raised concern regarding the authenticity of participants' responses, various other factors stemming from the researcher's positioning could influence the research outcomes. These factors encompass power dynamics in relation to research participants and the potential for participants to conform to what they perceive the researcher's expectations to be. Furthermore, the manner in which the data is analysed may also play a pivotal role in shaping the overall impact and conclusions drawn from the study. As a woman studying gender, how this could affect the recording, analysis and interpretation of

data should be carefully considered. But this should also be considered from a place of privilege - for example, I am white and therefore I should avoid looking at the issues addressed in this thesis through the lens of 'white feminism', and should instead be aware of and implement recommendations regarding intersectionality (as discussed in Section 1.5.3). However, Rode (2011b) states that as researchers "we need to add our own voice to this dialog as we discuss the relationship between digital anthropology and design", suggesting that it is perhaps not always a downfall.

3.2 Methodology Overview: Answering the Research Questions

In Table 3.1, an overview of the research questions addressed in this thesis, along with the methods employed to investigate and answer these inquiries is presented. To address these questions comprehensively, a set of research methods was applied, including innovation workshops, workplace observations, case studies, thematic conversation analysis, and insights drawn from feminist methodologies. This table provides a overview of each research question and the methods used to explore the various aspects of CS design meetings and the implications for design research.

3.3 Research Strategy: Applying an Agile Approach

The team observed in Chapter 7 followed an Agile Methodology, as did this research itself, and therefore an understanding of this is outlined in this Section.

"Agile software development is an umbrella term for a set of frameworks" focused on "on the people doing the work and how they work together" (Agile Alliance, 2020). 'SCRUM' is a framework that can be used to carry out agile software development. This framework, however, has been argued to be also appropriate for research to be carried out using. "Agile methods, initially used by cross-functional teams in software development projects, can also facilitate teamwork in collaborative research processes" (Senabre Hidalgo, 2018).

There has even been an Agile Research Network (ARN) set up, who have defined a model for research which they believe addresses the following concerns around standard methodologies: timeliness, relevance, accessibility (Sharp et al., 2014).

One of the 12 fundamental principles of agile development is; "at regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly" (Agile Alliance, 2020). This reflection is what is also adapted to be used in agile research methodologies, which is supported by Mara et al. (2013)

Research Question:	**Methods applied:**
RQ1 - What influence does gendered language have in the production of project meeting outcomes?	Innovation Workshops, Workplace Observations, Case Studies and Thematic Conversation Analysis
RQ1.1 - To what extent does gendered language and behavior impact the accomplishment?	Innovation Workshops, Workplace Observations, Case Studies, Thematic Conversation Analysis, and Feminist Methodologies
RQ2 - What methods are the most insightful for uncovering factors that impact how design meetings are accomplished?	Thematic Analysis and Conversation Analysis
RQ2.1 - How can these methods be informed by existing feminist methodologies?	Thematic Analysis, Conversation Analysis, and Feminist Methodologies
RQ3 - What concepts prove most useful in the examination of gendered interactions in project meetings?	Innovation Workshops, Workplace Observations, Case Studies, and Thematic Conversation Analysis
RQ3.1 - How are these concepts affected by gender?	Innovation Workshops, Workplace Observations, Case Studies, Thematic Conversation Analysis, and Feminist Methodologies
RQ3.2 - How is design impacted by concepts such as Hedging, interruptions, emotional labour, and project work?	Innovation Workshops, Workplace Observations, Mann-Whitney U Tests, Case Studies, Thematic Conversation Analysis, and Feminist Methodologies
RQ4 - What are the implications for design of this research?	Further Research suggestions based on the above output.
RQ4.1 - How does this impact our understanding of success or failure in design?	Further Research suggestions based on the above output.

Table 3.1: Which methods contribute to the Research Questions answered in this thesis.

who "advocate for an agile ethnographic method that embeds ethical evaluation throughout the process so that course corrections can be integrated at moments of inevitable breakdown and failure. By viewing failure and breakdown as useful, agile ethnography can help design researchers integrate local knowledge into an iterative design practice."

Mukhopadhyay and Gupta (2019) review the similarities between Agile as it's used for software development and Grounded Theory and how this is used in research. They do this alongside their comparison of the "underlying philosophy" behind these methodologies. "Grounded theory rests upon two key concepts: "constant comparison" and "theoretical sampling"" with data collection and analysis often happening simultaneously (Mukhopadhyay & Gupta, 2019). The conclusion based on these discussions is that in principle they are rather similar practices. Considering this, it is also important to reflect upon the work of Sandberg and Crnkovic (2017) who pose that agile methodologies have been a topic of research; as opposed to a means of carrying out successful research in collaboration in partnership with industry. In their case study, they adapted agile to fit their research, but understood that some roles such as "product owner" and "SCRUM master" were not adapted from the SCRUM framework to be used in their research. They also suggest that the scalability of this framework will need further research, however as this research is being carried out by a singular researcher, this concern may be negated in this instance.

It is important to emphasise that the data chapters presented in this thesis have been organised in the order in which they were conducted, reflecting the iterative nature of the research process. Each study presented its unique insights and findings, which were subsequently integrated into the subsequent investigations. This iterative and adaptive approach mirrors the principles of Agile Methodology. This adaptability has found resonance in research contexts, where timely and relevant outcomes are essential, especially given the unexpected move to being online due to the Covid-19 pandemic. The incorporation of agile principles, including regular reflection and adjustment, aligns with the dynamic and evolving nature of the research conducted here, allowing for course corrections. While Agile methodologies continue to be a topic of investigation, their application in this research highlights their potential as a valuable approach. In short, this research has followed an agile approach, with each study informing the next and contributing to a comprehensive exploration of the research questions posed.

3.4 Methodological Procedures: Innovation Workshops, Experimental Approaches, Case Studies, and Analytical Techniques

As outlined in Table 3.1, a combination of methods were applied in order to answer the Research Questions set out in this thesis. The first studies conducted were with students and staff in a University setting where innovation workshops were run in order, arguably an experimental approach. Then, due to the Covid-19 pandemic, the research had to move online, so methodologies around online focus groups were explored. Following this, an industry setting was observed over a number of meetings, giving a case study to be investigated. All studies ran alongside a survey to participants to gather information on gender identity and other characteristics. These studies were analysed using a combination of Thematic Analysis, with existing themes being pulled in from the methodology of Conversation Analysis. Most of the analysis carried out in this thesis was qualitative.

Qualitative methods were the most appropriate for this thesis due to several compelling reasons. By conducting a series of in-depth case studies, qualitative methods facilitated a comprehensive exploration of the how gendered language was used, allowing for a rich and detailed analysis of conversations that took place. While some basic statistical comparisons were performed, they were derived from the qualitative data, complementing and enhancing the overall understanding of the findings. This integrated approach not only provided a holistic perspective but also enabled the researcher to gain valuable insights into the intricacies of the research context, ultimately contributing to a nuanced interpretation of the research outcomes.

Burns (2000) separates methodologies into quantitative, qualitative and survey methods. In the introductory chapter to their book, Introduction to Research Methods, they outline the strengths and limitations of quantitative methods, or what they call the "scientific approach", and qualitative methods.

The main strength of the "scientific approach" is described as its "precision and control" (Burns, 2000) and that this allows a hypothesis to be tested "through a deductive approach" and the "use of quantitative data permits statistical analysis" which is argued to give a much stronger standing in measurable experiments. However, Burns (2000) also raises the main limitation of the scientific approach to be that "human beings are far more complex than the inert matter that is studied" and that this surfaces because "humans are not only acted on by a plethora of environmental forces, but can interpret and respond to these forces in an active way". And perhaps more relevant to the aims of this research, Burns (2000) observes that quantitative research "fails to take account of people's unique ability to interpret their experiences, construct their own meanings and act on these". This observation aligns very strongly

with the aims of this research.

"Qualitative research places stress on the validity of multiple meaning structures and holistic analysis, as opposed to the criteria of reliability and statistical compartmentalisation of quantitative research" (Burns, 2000). However, Burns (2000) acknowledges that "the problem of adequate validity and reliability is a major criticism placed by quantitative researchers on qualitative methods" but this criticism does not make the results any less valid. O'Leary (2017) argues that that if qualitative research is "inappropriately assessed according to positivist/quantitative criteria" then this is "simply a matter of using the wrong criteria for the job". O'Leary (2017) states that with the correct strategies, achieving credibility in qualitative studies is more than obtainable.

Another limitation noted by Burns (2000) as one of the "major limitations of qualitative research" is the "time needed for data collection, analysis and interpretation"; therefore this should be considered when choosing the methods and planning analysis. The advantages of qualitative research includes their ability to make connections between data collected that may otherwise have been missed. Burns (2000) also suggests that "qualitative descriptions can play the important role of suggesting possible relationship(s), causes effects and even dynamic processes".

As one of the aims of this research is to uncover relational themes around group dynamics and diversity (**RQ1**), this advantage seems the most appropriate reason to justify qualitative methodologies.

Bell (2006) poses that "no approach depends solely on one method". It could be suggested that a mixed method approach allows triangulation and more accurate results to be analysed. This aligns with the views of Denscombe (2010) who states that "it is evident that social researchers use mixed method strategies" to "improve accuracy", give "a more complete picture" and that each method compensates the others' strengths and weaknesses. However, Denscombe (2010) also states that "the order of which the methods/strategies are used is significant" and that the sequence selected both reflects the beliefs of those completing the study and how the combination of methods best works. An example of the combination of methods can be found in Chapter 5 and Chapter 7, where qualitative methods are applied to extract data from a transcript, and a quantitative method is applied to analyse a particular aspect of this data: Hedging.

This Section outlines how each of these methods were applied, and following this, how they were analysed.

3.4.1 'Measuring' Diversity

When it comes to one of the main topics of this thesis, gender, this falls under the category of diversity, and therefore it should be considered if or how this can be

'measured'. Bartky (1990), however, rejects the idea that people can be measured, and looks at the structure of human experience itself. Bartky (1990) also ties this into feminism and how the structure of the human experience with regards to gender can affect their mind-set. Although gender can be argued to be significant, there are many other factors which define a person's character. Diversity can be 'measured' (or categories can be assigned) based on gender, race, and social-economic background, but is there a way of not limiting the measure to these areas?

Furthermore, it should be considered when it is appropriate, if ever, to 'measure diversity'. Applying Feminist Methodologies (Section 3.1) even when gender or diversity is *not* the topic of research, it is suggested that these categories are disclosed regardless so that those reading and using the research in the future are able to understand the *context* of the study and therefore any impact this may have had on results. This section (3.4.1) reports on how diversity could be 'measured' for both reporting and analysis; and how the decision to run surveys was reached.

3.4.1.1 Self-identification

There is very limited literature on self-identification as a measure of diversity. However, Dehanas (2016) adopted a self-identification ranking exercise, to allow participants to choose for themselves what criteria made themselves unique, and therefore perhaps diverse. To give the participants some guidance, they were given a set of cards with pre-filled labels for them to add, but also gave them blanks cards to write down any additional identities which may have been missed.

Giving participants pre-filled cards, as shown in Figure 3.1, will limit the number of options a participant can choose from, making the results easier to analyse but this may be very restrictive and fail to take account of lived experience which has shaped a person.

Giving participants empty cards, as illustrated in Figure 3.2, and allowing them to write anything that defines who they are in the cards may make analysing the results more difficult to analyse, but the data collected may be more accurate as participants would not be forced into pre-existing categories.

3.4.1.2 Traditional Surveys

The benefits of a traditional survey include the ability to measure quantitatively and place a numerical value on the differences between participants. As well as this, a survey may be a comfortable way of divulging information for participants, as falling into a bracket could be a less personal way divulging who they are.

However, when it comes to measuring diversity, a 'box ticking' exercise, despite being easy to measure, may have two detrimental effects. A lack of description with discrete characteristics will enforce participants to place themselves 'in a box' in which

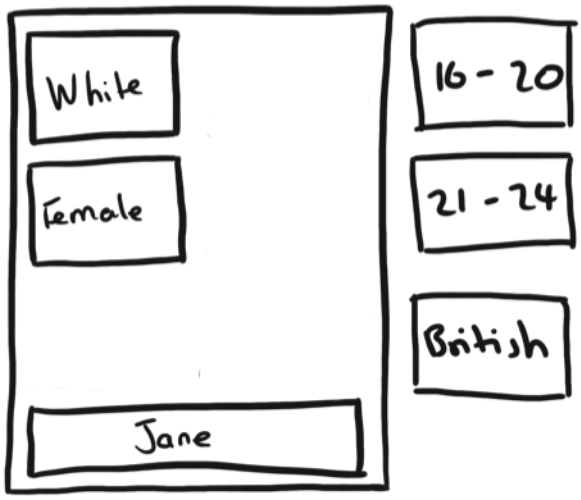

Figure 3.1: Self-identification technique based on a set number of pre-filled cards.

they may not feel comfortable, although many surveys include an "other" option for this reason. Furthermore, the participants may have had distinguishing features not asked about at all. It is impossible to design a survey that could account for every experience a person has ever had and every aspect of their life and personality.

3.4.1.3 Summary: Using both self-identification and surveys

A collaborative project is currently in progress with another researcher in the Psychology department at Lancaster University and this author, where participants were given a self identification exercise, followed by a survey, and the results compared. The results of this, although unpublished and still in progress, found that there was seemingly little difference in the way that those identified when tasked with first the self-selection task, and then a survey. This thesis used surveys as a way of gathering identities of participants, but further work should be carried out beyond this thesis to explore this hybrid approach further.

3.4.2 Experimental Methods

Experimental methods are an important component within scientific research, providing a systematic and structured approach to investigating and understanding various phenomena (Kitchenham et al., 1995). In the context of this research, experimental methods refer to a rigorous framework for gathering empirical data by manipulating one or more variables and observing their effects on specific outcomes. This approach

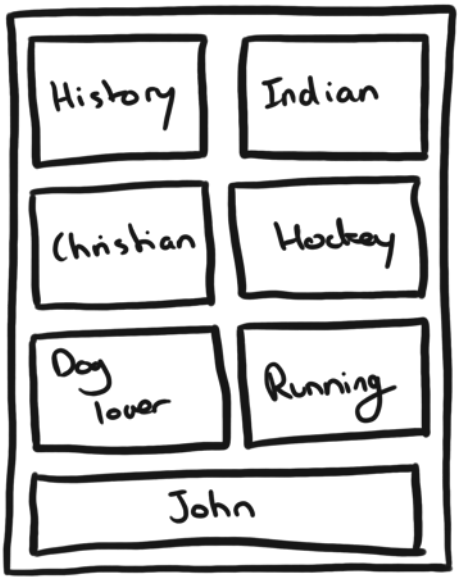

Figure 3.2: Self-identification technique based on blank cards filled in by the participant.

allows for the systematic examination of causal relationships and the exploration of how certain factors influence particular behaviours or processes.

In this research, groups of university staff and students were engaged with in a series of innovation and ideation exercises (see Section 3.4.3) to delve into the dynamics of creative problem-solving within an educational context. The experimental subjects, consisting of these groups, played a central role in providing firsthand insights into the processes at play. Their active involvement allowed an observation and analysis of how individuals from different backgrounds and roles approached these exercises.

The experimental objects in this study encompassed the innovation and ideation exercises themselves. These exercises served as the objects to which the participants applied their methods and tools. Structuring the research in this way enabled the research to explore how university staff and students interacted with these exercises, shedding light on their innovative capabilities and potential differences in their problem-solving approaches. This experimental method provided a comprehensive exploration of creative and problem-solving processes within the educational context, offering valuable insights that may have implications for educational practices and collaborative initiatives.

3.4.3 Innovation Workshops

During the initial year of the PhD study, an exploration was undertaken to understand how innovation and creativity could be effectively measured. Two techniques were considered; Guilford's Alternate Uses and the Kirton Adaptation-Innovation Inventory (KAI) (Fagan, 2004; Wilson et al., 1954), which sought to identify adaptive and innovative creative styles and how these can be measured. However, the analysis revealed that these methods did not yield the desired insights and proved to be less helpful for the research objectives, as the research questions in this thesis centred more around the impact of conversation.

Nonetheless, the understanding of how innovation occurs remained vital, particularly concerning its susceptibility to gendered language. The studies held in a University setting were done using 'Innovation Workshops,' a form of focus group designed to foster a creative thinking environment through conversation (Davis, 2019). However, using this approach raised concerns about decision-making processes. It became apparent that while shared input could lead to stronger outcomes, it also introduced challenges in terms of ensuring that all participants' opinions were heard and that effective compromises could be reached. Striking the right balance between group collaboration and individual decision-making emerged as a significant challenge in fostering innovation.

The innovation workshops centered around the process of ideation were explored through the case studies in the university settings in this thesis. This innovation method involved noting ideas on sticky notes related to a given topic, while being mindful of potential distractions. Ideation played a crucial role in the workshops, with differences arising in the topics and their derivation.

The examination of how innovation occurs encompassed concepts such as 'Imaginary Brainstorming,' 'Concept Trees,' 'Creative Challenge,' and 'Random Stimulus' (Silverstein et al., 2013). Each method offered unique advantages and limitations, with 'Random Stimulus' being hailed for its impartiality in generating ideas. However, existing literature highlights the challenge of objectively measuring creativity, particularly when existing solutions were lacking or ideas were similar.

One of the early areas of research considered throughout this research was to look at creativity as a result of increased diversity. However, as the research moved forward, the focus shifted towards the influence of gendered language on innovation processes itself, not on how creative the participant groups were. Whilst the initial attempt to measure creativity proved less fruitful, gaining a comprehensive understanding of the innovation mechanisms became paramount to grasp how gendered language could impact and shape innovation outcomes. Following this, the research continued to investigate the relationship between language, gender, and the innovation process, aiming to shed light on potential biases and their effects on creativity and ideation, and ultimately design.

3.4.4 Case Studies

A case study is an "intensive analysis of an individual unit", where boundaries are drawn around the individual unit of study (Flyvbjerg, 2011). The case studies throughout this research included bounded workshops within a university setting, and then later industry meetings. Whether "case studies" should be used as methods or as an approach, has been debated in the literature for many years (Hamel et al., 1993). Emerging from anthropology and sociology, case studies allowed the observations of the emergence of particular traits in a consolidated manner (Hamel et al., 1993). However, Kitchenham et al. (1995) outline case studies as a single occurrence of empirical or experimental data.

This thesis adopts a case study approach, a deliberate choice that, while it may limit the generalisation of findings, carries significant advantages. Instead of pursuing broad generalisations, this approach offers the opportunity for a nuanced and comprehensive exploration of the intricate interplay between gender, language, and design meetings within diverse and distinct settings. By delving deeply into specific cases, this research observes a number of factors that influence and shape these interactions. This level of granularity allows for a more in depth understanding of the unique contexts, dynamics, and complexities at play, ultimately presenting insights that may have been obscured by a more generalised research approach.

3.4.5 Analysis

When it comes to the methods of analysis used in this thesis, the main method used is Thematic Conversation Analysis, derived from a combination of Conversation Analysis and Thematic Analysis. This allows the analysis of both *what* is being said, as well as *how* it is being said. This fits into qualitative analysis methods, and where other methods have been used in the data chapters (e.g. Chapter 5 where a basic statistical comparison was used), this has been outlined as relevant.

3.4.5.1 Outline for analysing qualitative data

O'Leary (2017) highlights the importance, when carrying out qualitative data analysis, of recognising the need for "ongoing rich engagement with the documents, transcripts, images and texts that make up your raw data" and that "qualitative data demands cycles of iterative analysis".

The steps for the analysis of qualitative data outlines by O'Leary (2017) are as follows; 1. "Identifying biases and noting overall impressions." 2. "Reducing" which is described as "an essential step in moving from messy raw data to rich understanding." 3. "Searching for patterns and connections." 4. "Mapping and building themes." 5. "Buildings and verifying theories." 6. "Drawing conclusions."

The first of these stages ties in with the discussions around feminist methodologies. Removing bias as the analysis is carried out can be "hazardous, since the interpretations are always intertwined with a researcher's biases" which can be "both recognised and unrecognised, conscious and subconscious" (O'Leary, 2017).

"Reducing and coding into themes" begins with a "line by line" analysis of all data sources (O'Leary, 2017). The ways of doing this can be broken down into "exploring words", "exploring concepts", "exploring linguistic devices" and "exploring non-verbal cues" (O'Leary, 2017). Using a set list of terms and searching for these in may be an appropriate way of detecting prominence of key areas within a text (De Hertogh et al., 2019). However, in doing so the results of a study may be predetermined by the list of terms. This could be argued as creating a scope, however in exploratory research, this could be restrictive. De Hertogh et al. (2019) chose the search terms because they felt the terms were broad enough to not restrict the issues explored.

This thesis used a combination of both, an existing list of themes gathered from Conversation Analysis, as well as the allowing of additional themes to come forwards as the Thematic Analysis was carried out.

Once patterns and connections have been uncovered, and relevant themes have been explored, then "the quest for meaningful understanding moves to an exploration of the relationship between and among various themes" (O'Leary, 2017). Mapping and buildings these themes through a visual diagram is described as an appropriate way to explore the themes in more depth and observe any overlap.

The following methods and types of analysis outlined by Yoo et al. (2012) are suggested as being "likely to yield useful insights on the need for multiple methods and novel analytic tools". These theories and methods are based on computation techniques, which could be fitting given the field of research.

In this thesis, a combination of Conversation Analysis (CA) (outlined in Section 3.4.5.2) and Thematic Analysis (TA) (outlined in Section 3.4.5.3) were applied.

Merging CA and TA, allowed the examination of both the content of the conversations (*what* was being said) and the manner in which it was expressed (*how* it was being said). This allowed for a more nuanced and comprehensive qualitative analysis, enriching the understanding of the data. Moreover, the use of thematic Conversation Analysis provided a structured framework, combining an existing list of themes from CA with the flexibility to identify additional themes as they emerged during the analysis. By combining these approaches, a deeper understanding of the conversations and their underlying themes were extracted, whilst also allowing new insights to come to light.

3.4.5.2 Conversation Analysis

Conversation analysis (CA) is "an approach to the study of social interaction that emerged through the collaborative research of Harvey Sacks, Emanuel Schegloff, Gail Jefferson, and their students in the 1960s and early 1970s" (Sidnell, 2010). Boden (1994) describes Sacks et al. (1974)'s definition of CA as "a way of of creating an observational science out of sociology". Feminist Conversation Analysis is carrying out CA critically reflecting on any research previously carried out using CA, or how the method is used. Kitzinger (2000) claims that "it is clearly not the case that CA is (or can readily be made) compatible with all variants of feminist research", suggesting that only certain elements of the method should be adopted to carry out truly feminist research. Feminist methodologies are built on the argument that the traditional "'rules' of research have embedded within them an unconscious patriarchal bias" (O'Leary, 2017). One of the main concerns around this is that this goes undiscussed and any prior knowledge, assumed as general knowledge, may have come from a place of male bias. To overcome this, any research carried out must not rely on any previous research when results are analysed. Davis (2019) argues that diversity is "not only essential as a goal of intersectional feminism, but also as a means of continuing success for digital movements", outlining that this is especially important in the digital sector.

Butler and Fitzgerald (2010) use CA to examine how identities play a part in the interactions participants have through language, in their case a family having breakfast. Their paper analyses "the in-situ relevance of identities—how they are produced over turns and between participants, and how they may be resisted, transformed and negotiated." This may be of particular relevance when analysing gender differences and group activity due to their self-identified gender and how this effects interactions. The way in which Butler and Fitzgerald use CA in order to complete their analysis on a very small amount of speech (one hour) but in a great amount of detail. In doing so, the level of detail which they're able to analyse in leads to some objectively interesting finds.

When it comes to "Feminist Conversation Analysis" there is an ongoing debate about the legitimacy of the work. The ongoing debate held amongst academics is spearheaded by Kitzinger (2000, 2008) and Wowk (2007). In their 2000 paper on the topic Kitzinger (2000) argues for the value of CA for feminist research. They counter criticisms of CA as anti-feminist regarding social theory and show that CA is compatible with social constructionist, postmodern and queer feminisms which treat gender and sexuality as "accomplishments". They use CA to develop a feminist approach to date rape and sexual refusal - which challenges the "just say no" advice. Furthermore, they analyse talk in which people "come out" and show that speakers use turn design to avoid sexuality becoming topicalised. They argue that this paper shows that CA's criticised features are useful for feminism and concluded that CA has

a lot to offer feminism. A response to this paper in 2007 by Wowk (2007) critiques the claims that Kitzinger (2000) was genuinely doing CA and ethnomethodology. They also take issue with each of the social theory links, participant orientations and micro-macro distinctions. Wowk (2007) argues that Kitzinger (2000) fails to appreciate the fact that their formal analysis and CA can be compared to one another and suggests attempts to supplement CA with feminism undermines the integrity of CA. As well as disputing the characterisation of CA social theory and as being subjective, they also critique the data analysis; they question treating some talk as "coming out", the use of field notes, and personal experience. They suggest that participants are not orientating to talk as Kitzinger (2000) analyses it. Their main argument, in the opinion of this author, is that the analysis forces the data to fit feminism rather than allowing the data to drive the analysis. They conclude that claims to feminist CA show deep misunderstandings and undermines the analysis of CA. In defence of their work, in 2008 Kitzinger (2008) rebuts claims that their work is not genuinely CA and challenges the restricted version of CA analysis that many leaders also follow. They address criticisms regarding the use of field notes, and "analyst as participant" accounts. To rebut this they show comparisons across conversations common in CA, provides detailed analysis of turn-taking and sequence organisation, and they go over CA understanding of "participants' orientations" in the fine details of talk. They conclude that Feminist CA contributes to basic CA findings on turn-taking and sequence organisation.

Given the above, within this thesis Conversation Analysis was not used other than the standard themes and traits of CA being taken to seed a thematic analysis. The conventional coding of Conversation Analysis as a methodology was not followed throughout this thesis, although the traits of conversation derived from the methodology, outlined in Section 2.4.1, were used to carry out a thematic analysis.

3.4.5.3 Thematic Analysis

Thematic Analysis is used to extract themes from a text, or "thematic analyses move beyond counting explicit words or phrases and focus on identifying and describing both implicit and explicit ideas within the data, that is, themes" (Guest et al., 2012). Applied thematic analysis ties together "grounded theory, positivism, interpretivism, and phenomenology" into "one methodological framework" (Guest et al., 2012). However, the suggestion that thematic analysis ties all these methodologies together is a bold claim. For example, positivism and interpretivism are quite different on what counts as knowledge. Understanding how thematic analysis ties into methodologies at large was crucial to be able to carry this research out effectively. However, in carrying out a thematic analysis, it was important not to lose any gender difference that would have presented themselves through Conversation Analysis.

Thematic Analysis has more recently been embedded in a strict process of coding and labelling data, as outlined in the six stages of TA outlined by Braun and Clarke (2006); familiarisation, coding, themes search, themes review, themes definition and reporting. However, in the original emergent work on TA coding was hardly noted (Glaser & Strauss, 2017), and the emphasis was on the themes themselves, as was the following work of Glaser (Gläser et al., 2017) it is this definition of thematic analysis which shall be conducted in this research.

3.4.5.4 Thematic Conversation Analysis

Thematic Conversation Analysis (TCA) will be a combination of Thematic Analysis and CA, allowing conversations and discussions to be analysed and the main topics to be examined in further detail. Building on fundamental principles from CA, such as turn-taking (Kitzinger, 2008) and language used (E. H. Stokoe & Weatherall, 2002), this process will also enable themes outside of the conversation structure to be examined such as; the types of ideas being brought forward, the meaning of the language being used. However, this will also allow classic CA examples of group practices to be examined such as leading and turn taking.

3.4.5.5 Statistical Comparisons

The statistical comparison used in this thesis is the Mann-Whitney U Test (Mann & Whitney, 1947). This analysis emerges as the most appropriate method for comparing two lists of language occurrences in meetings due to its robustness against non-normality and its ability to handle tied data, which often arise in language analysis. A normal distribution was incorrectly assumed and used for publication early in the PhD, but this has been corrected for this thesis, and the Mann-Whitney U Test has been used in Chapters 5 and 7. This was done using an R script (shown with the first set of test data in Figure 5.5) that outputted a W value and a p value.

The interpretation of the Mann-Whitney U Test's W value depends on the context of data, sample sizes, and distribution of ranks. A high W value, such as 5, suggests greater rank separation between samples, potentially indicating a significant difference. What was used throughout this thesis, however, was the p value. The Mann-Whitney U Test assumes a two tailed test, and with a standard confidence level of 0.05, the p value should therefore be compared to 0.025 to outline if there is enough evidence to reject the null hypothesis.

The statistical analysis outlined here does not make up a large proportion of the data outlined in this thesis, as the focus of this work is to look at the subtleties that can arise through the case studies, and the small sample sizes would unlikely lead to significant results regardless. But what the Mann-Whitney U Test does provide is an

indication of whether average uses in the case studies observed supports or contradicts existing literature.

3.5 Critical Considerations: Reflexivity, Generalisation, and Ethical Frameworks

Any researcher much critically reflect upon the methodologies being applied, particularly when Feminist Methodologies (discussed in Section 3.1) are being applied. This Section outlines how Intersectionality and Reflexivity are linked, as well generalisation and ethical practices. Only by considering these areas will equitable research be able to be carried out.

3.5.1 Intersectionality and Reflexivity

Reflexivity, at its core, refers to the effect the researcher can have on the research, and can be described as another understanding of the way in which knowledge is formed. Examples of this within HCI are well researched (K.-L. Chen et al., 2017), but with a lack of specificity given to the impacts of Intersectionality (although some considerations are given to one characteristic at a time, e.g. gender (Bardzell & Bardzell, 2011)).

> "*Calls to reflexive social inquiry do not maintain a simple separation between subject and object or between the knower and the known. Reflexivity involves turning back on oneself in order that processes of knowledge production become the subject of investigation.*" - May, Perry, et al. (2014)

Using the standard sociological view of reflexivity (such as the work of May, Perry, et al.), this requires that the researcher considers their own characteristics and how they interact with or impact on the interpretation and understanding of Intersectional identities. For example, Locke, who found that one interview in their research "shattered" their own positioning as a researcher when it came to heteronormativity.

Slack (2000) criticises debates on reflexivity, such as that of May (1999), for overlooking the importance of grounding their claims in the everyday experiences of society members. Slack (2000) distinguishes between 'essential' and 'stipulative' reflexivities, with stipulative reflexivity being the primary concern of sociological researchers who shape members' views by focusing on the analyst's perspective. Slack (2000) advocates for essential reflexivity, an ethnomethodological approach that emphasises understanding members' reflexivity through observable natural language actions, a main focus of this thesis. Slack (2000) argues that ethnomethodology's goal is to describe how society members, not researchers, create and recognise contextually

relevant social structures, emphasising the importance of faithfulness to real-world phenomena in ethnographic research.

Alongside this, the consideration of participants in research involves reflexively accounting for their interactions, thereby making the actions and interactions clearly visible. What should be carefully considered in line with this, is how Intersectionality might feature in participants' accounts, aligning with what Sacks might call a 'membership categorisation devices' (Sacks, 1992), as further explored by Boden (1994). Examples of this when it comes to gender and HCI, can be seen in existing work on 'Hedging' where women are (or appear to be) anxious in the ways in which they express uncertainty (Ashcroft, 2020b, 2022b; Holmes, 1986), but need to be understood further when it comes to intent and reflexivity.

Fuller (2020) states that there are three areas of reflexivity: "reflexivities of complacency", "reflexivities that discomfort", and "reflexivities that transform". It could be suggested that these are approaches to Intersectionality too. For example, "reflexivities of complacency" are defined through the confirmation of "a self-narrative and identity as feminist (e.g., experiencing, recovering from and confronting a range of gender related oppressions), upwardly socially mobile (e.g., moving from manual working-class to educated middle-class, into a profession), anti-racist (e.g., calling out, teaching, and researching about racism) and social activist (e.g., campaigning for human rights , supporting professional activism about women's careers in education)" (Fuller, 2020). This supports the example given above from Locke (2015) who self reflected upon their complacency in the methods they had designed for their research. Fuller (2020)'s second stance of reflexivity, "reflexivities that discomfort" align very strongly with the active "work" that many Black Feminist writers encourage readers to engage with (Eddo-Lodge, 2020; Saad, 2020) - which could certainly be described as an Intersectional practice, as those partaking this must uncover their own identities. The third area of reflexivity, described by Fuller (2020), is that of "reflexivities that transform". An example used to illustrate this is the aim of "de-centring whiteness whilst simultaneously acknowledging it" - this may be seemingly impossible, and a contradiction, but if this was achieved, it would be truly transformational. "Engaging with reflexivities that discomfort has the potential to transform self-narratives, construct relationships, and carry out and interpret research differently" (Fuller, 2020) and this should therefore be considered in significant depth and with as much critical self reflection as possible before any research is designed or conducted.

This ethical obligation that researchers have to ensure their research does not contain any bias, supports Feminist Methodologies (as outlined in Section 3.1), and the issues around reflexivity as discussed in this Section. This obligation is also supported by Christoffersen (2018) who found "that in spite of the growth of critical methodological approaches, dominant texts lack meaningful consideration of

researchers' intersectional positionality" and later by Henriques et al. (2023), who once again raise the notion of intentionally looking at gender differences and not deliberately choosing to be "gender-blind". This overlap between Intersectionality and Reflexivity should have implications for HCI research going forwards, and has been shared in publications resulting from this thesis.

3.5.2 Generalisation

When it comes to generalisation, Sharrock and Randall (2004) emphasise that the only outcomes that can be reported upon are the results that were found within the study. This thesis presents a series of case studies, and shows examples of methodologies being applied in a CS setting, with a subtle analysis showing examples of both supporting and contradicting existing literature. However, these are case studies and generalisation should be avoided. This is not to say this thesis makes no contribution, but to acknowledge that what is found may only be an indication of how this area of knowledge can be further investigated. The 'angry ethnographer' is an example given by Crabtree et al. (2013) in which they ask "how many bloody examples do you want?" Whilst understanding that context of the study matters, Crabtree et al. (2013) make the argument that unless a sample size of one hundred percent is achieved, there is not an ideal number of 'examples'. Using an example of a family planning a day out, they argue that this could be generalised due to the context in which it sits, however they recognise that this sits in the wider context of 'social ordering' and so can only be generalised to a certain extent. This would seem to make logical sense, it that generalisation must happen after a certain point, as long as context is understood and made clear.

> "*Not only is the underlying pattern derived from its individual documentary evidences, but the individual documentary evidences, in their turn, are interpreted on the basis of 'what is known' about the underlying pattern. Each is used to elaborate the other.*" - Garfinkel (1967)

Garfinkel (1967) underscores the concept of treating an actual appearance as a document or representation of an underlying pattern. The above quote suggests that when researchers study a particular instance, they do so with the assumption that this instance reflects or points to a broader, presupposed pattern. This interplay between the individual instance and the underlying pattern is dynamic, is key to consider.

In the context of replicability and the uniqueness of individual lived experiences, it is important to recognise that just because evidence is not replicable doesn't make it any less valid. One could but the same three people in the same room three times, and ask them to design software, and every time they would come out with something different due to every person having a unique lived experience. This highlights a

fundamental aspect of qualitative research: the richness and complexity of human experiences and interactions.

In qualitative research, especially when looking at case studies involving conversation, the goal is often to delve into the unique and context-dependent aspects of the event. This approach acknowledges that people bring their individual perspectives, backgrounds, and histories to any given situation. Therefore, it is expected that outcomes may vary based on these individual differences.

However, this diversity of experiences doesn't diminish the value of case studies. Instead, it highlights the importance of understanding context and recognising that generalisation may not always be the primary objective. Case studies offer in-depth insights into specific situations Hamel et al. (1993). While they may not be easily replicable in the traditional sense, they contribute to our broader understanding by revealing the nuances and complexities that exist within the real world.

Supported by Garfinkel (1967), qualitative research, including case studies, can provide valuable insights even when findings are not easily replicable across different contexts. They can emphasise the richness of individual experiences and the need to appreciate the diversity and uniqueness inherent in human behaviour and social interactions. Conversation analysts and ethnomethodologists often draw on the idea of a 'perspicuous setting' when dealing with questions about generalisation. They suggest that rather than claiming that their analyses can be easily generalised, they argue that what they find in the settings they choose to analyse can and should inspire work in other settings to establish what similarities and differences might be discovered. The idea of a 'perspicuous setting' is well explained by Lynch (2016) where they link this to Garfinkel and Wittgenstein's ideas about 'perspicuous representations'. As Lynch states; "a perspicuous site is a researchable organization of activity in which participants raise, address, and locally explicate problems, topics and conceptual distinctions" (Lynch, 2016) and is linked to the ethnomethodologists' determination that phenomena of whatever kind should be investigated rather than merely theorised. The task then becomes one of determining exactly where the phenomena of interest is manifested – where might we find gendered talk taking place? Mondada (2018) also uses the idea of a perspicuous setting in a number of studies, from driving cars (Mondada, 2018) to performing surgery (Mondada, 2014). This approach, while common in Ethnomethodology, also features strongly in more conventional sociological accounts. The 1960s sociological classic 'The Affluent Worker' (Goldthorpe et al., 1971) explores the extent to which working class people had changed their attitudes, values, and voting preferences as a consequence of newfound wealth. It chose Luton as a fieldsite because the town, with its high-paid jobs in new car factories, was believed to be exactly where such phenomena, if they existed, would be found. Understanding the concept of perspicuous settings is crucial in social research, particularly in fields like conversation analysis and

ethnomethodology. By recognising the significance of specific contexts and settings in uncovering phenomena of interest, researchers can gain deeper insights into complex social dynamics. This approach encourages a focus on empirical investigation rather than mere theorisation, emphasising the importance of identifying where the phenomena of interest manifest, which is the aim of this thesis.

When it comes to the continuous achievement of orderliness and recognisability in the social world, overlooking specific details in favour of generalisation can lead to underlying reasons being overlooked (Rawls, 2003). What this thesis presents is how existing methods and frameworks can be utilised in CS to explore relationships between gender, conversation and design, therefore no generalisations about participants should be drawn from these case studies, but examples are presented showing how gendered language *may* impact how design in CS takes place.

3.5.3 Ethics

Doing ethical feminist research is crucial in ensuring that the study is conducted with sensitivity, respect, and inclusivity. As a researcher, I recognised the significance of adopting the intersectional approach that acknowledges and addresses the diverse experiences of individuals across various genders, races, and backgrounds. To gather data and ensure ethics standards were met, I sought approval from the University's ethics committee to conduct surveys, run innovation workshops, and record meetings in an industry setting. By adhering to ethical guidelines and obtaining informed consent from participants, I ensured that their rights and privacy were protected throughout the research process, as well as ensuring all data was stored securely.

3.6 Summary

This Chapter has outlined the methodological approaches and procedures carried out in this research. A combination of methods were used, including innovation workshops, workplace observations, case studies, surveys, and analytical techniques such as thematic conversation analysis. The research adopted an agile, iterative approach with each study informing the next. Qualitative methods facilitated an in-depth exploration of group conversations and dynamics. Quantitative analysis provided complementary statistical insights. The methodological choices align with the research questions, as outlined in Table 3.1, which centre on understanding conversations in computer science design meetings and the impact gendered language may have on this. Ethical considerations and reflexivity were critical throughout this research, guided by feminist methodologies. In summary, the mixed methodological strategy provided opportunity for a subtle analysis into the intricacies of gender, language and design within CS.

Chapter 4

Library Innovation Workshop: Paper airplanes flying. . .

"*The thing I've got, but I don't know anything, but my idea is...*" - P1-W

"*I think this is the most important? Someone tell me I'm wrong.*" - P7-M

In order to consider how innovation workshops could be run to gather data for this research, a workshop was observed focusing on ideation regarding the following two themes in the setting of a university library:

1. Having an intelligent library
2. Discovering digital resources in a physical world

The desired output from the workshop was a bank of problems and potential solutions, as well as three somewhat detailed ideas from each group, and one detailed idea. This 'final idea' should have a press release, designs, and have be valuable to the user[1]. The group was run as part of a collaboration between the two development teams from different departments within the University.

The session was observed, and field notes were taken in order to uncover how the workshop ran and improve upon the methodology for further studies and data collection. It should be considered that this author was both the facilitator of the workshops run, as well as the researcher in this research. The observations and notes are summarised as follows.

The session began by splitting the participants into two groups, each with six members. These were labelled as 'table 1' (T1) and 'table 2' (T2). The layout of the

[1]This is using the Adobe Kickbox ("Kickbox Foundation", 2021) framework as outlined in previous Chapters, and the value is determined by asking the audience.

tables was as below in Figure 4.1, with participants being given participant numbers e.g. P1, P2, P3 etc. based on where they were sat.

In terms of the gender of the participants: P1, P4, P5 and P9 identified as women, and P2, P3, P6, P7, P8, P10, P11 and P12 identified as men. For ease of reading, and with the understanding that gender is not binary but those in the group happen to identify as men or women, the following labels will be used with "-M" indicating the participant identifies as a man, and "-W" indicating the participant identifies as a woman; P1-W, P2-M, P3-M, P4-W, P5-W, P6-M, P7-M, P8-M, P9-W, P10-M, P11-M, P12-M. No other socio-demographic data was gathered - a limit of this pilot and a lesson which was carried forwards.

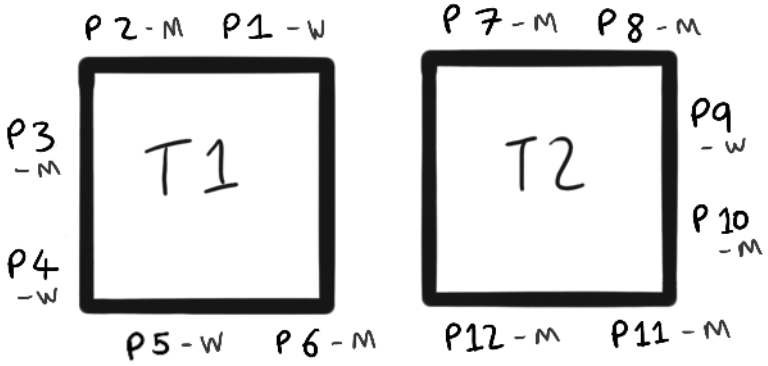

Figure 4.1: Seating plan for pilot study.

Each participant was asked to ideate problems around the two workshop themes in silence for 10 minutes. They were then asked to pair up and explain their problems to each other for 10 minutes, then after this to present the other person's problems to their team. The teams were asked to self-select who spoke first (no guidance was given).

T1's order of speakers was sporadic but alternated between male and female participants, with one of the women speaking first. T2 went around the table clockwise.

T1 initial order of speakers: P1-W, P3-M, P5-W, P6-M, P2-M, P4-W

T2 initial order of speakers: P7-M, P8-M, P9-W, P10-M, P11-M, P12-M

The participants were then asked, as a team, to group the problems into problem

categories. In this process, on T1, all the men were very vocal, as was P1-W. The other two women on this table were very quiet and hardly spoke. On T2, all participants seemed to contribute towards the groupings.

The next phase was 20 minutes of silent ideation, where participants were asked to come up with digital solutions to each of the problem categories. It may be useful in the future, if participants included their participant ID on the back of each post it to make these easier to identify.

All participants were then asked to share their ideas, and to rank them in order of importance under each category. On T1, P2-M took the lead, and on T2 P10-M took the lead.

On T2, the only woman on that table, P9-W, seemed to be more vocal then the women on T1. It is also interesting to note than when 'pitching' the ideas to T1, P2-M was very enthusiastically sharing and really trying to sell his ideas, whereas P1-W was mostly just reading her ideas from the sticky notes, although this may have been personality differences, and not gender. This is examined in greater detail when it comes to literature and practice later on in this thesis.

As people shared their ideas, and discussed ranking, it became apparent that these discussions may be the most data rich; however due to running two groups at once, recordings were difficult to use. In future workshops, it was decided that there should only be one group running at a time. It also became apparent that not enough time was allocated for this segment of the workshop.

After a break for lunch, participants were then asked as a team to pick their top three ideas or solutions. T2 chose very quickly, as they only had five problem categories. Whereas T1 took longer than T2, but they had eleven categories to go through.

The teams then had 20 minutes to complete a Business Model Canvas (Strategyzer, 2019) for each one of their top 3 ideas. The Business Model Canvas is a concise, one-page tool utilised by organisations to visually represent and analyse their business model (Strategyzer, 2019), and in the context of this study was done with the hypothetical tools ideated. It comprises ten key elements, including the problems, solutions, the unique value proposition, the unfair advantage, key metrics, the unique selling point, the paths to the customer, who the target customers are, the cost structure and revenue streams. This canvas serves as a vital instrument for gaining clarity, alignment, and innovation within an organisation (Strategyzer, 2019).

Figure 4.2 shows one of the three ideas raised by T1, based around struggling to find somewhere to study in the library. These cards worked well and encouraged discussion within the team about the details of the product they were designing.

Only 20 minutes were originally allocated for this, but as neither group were complete in this time, this was extended to 40 minutes. However, even after this team T1 still requested more time. Observations showed that at T1 it was mostly the

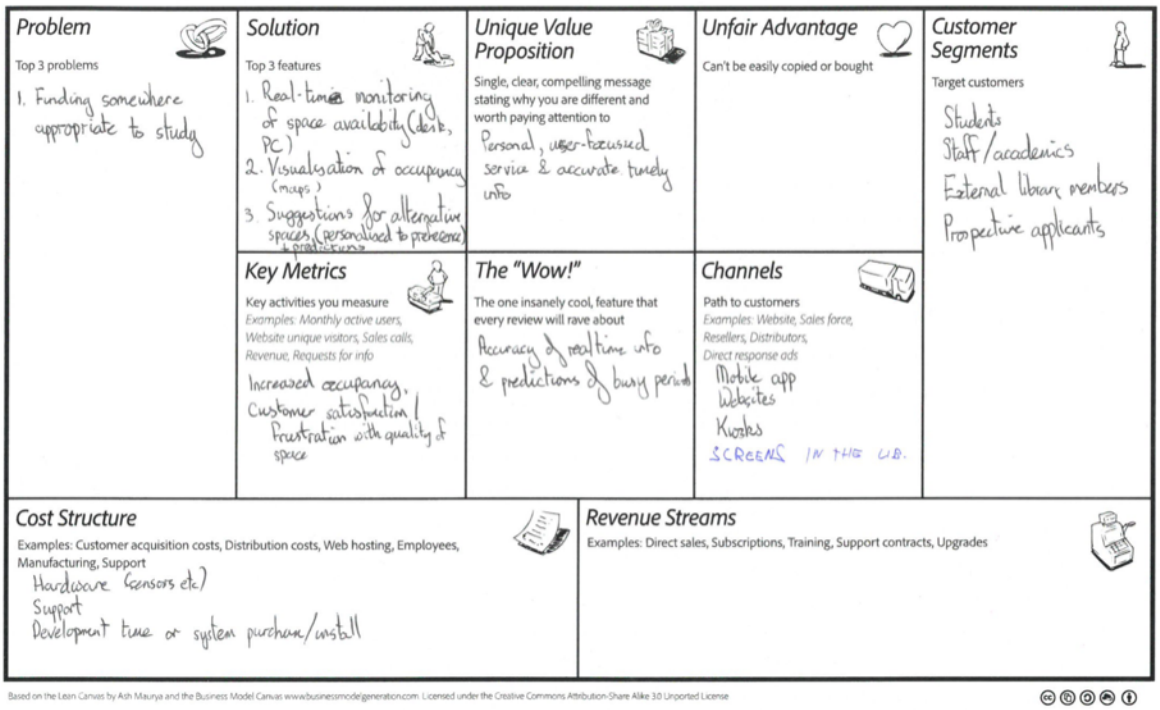

Figure 4.2: Example Business Model Canvas, take from T1 in the pilot study.

male participants talking and the women did a lot of nodding. It may be interesting to see how this could be measured. Therefore, once again, it will be these conversations that are analysed more closely later in this body of work.

Then, each team was asked to select their 'top idea' and produce:

1. The idea in a sentence
2. A press release
3. Designs
4. Proof of value

At T1; P2-M, P1-W and P3-M mainly chose which idea was the best one to work on. It seems important to note that these three participants were staff members, and it was the students who did not select the top idea, suggesting power dynamics would be an interesting topic for further studies. At T2; P11-M and P12-M chose the

idea, but then asked P9-W (a student) what she thought of the idea to confirm this. Generally, it seemed that T2 discussed this more than T1.

T2 instantly split into groups, each working on something for the final contribution. P7-M and P9-M, on the press release, P10-M and P11-M on screen designs and P12-M and P8-M on asking the students in the library what they thought of their idea.

T1 however did not spilt into groups. P2-M and P1-W began by starting the press release, while the others sat and did nothing. It was then suggested by myself, as the facilitator, that they split the roles. P2-M then asked P6-M to take everyone else to go and do designs. Once they had done this, they then took the designs to students in the library for feedback.

Both teams ended up presenting incredibly similar ideas and designs, some UI designs for which can be seen in Figure 4.3 by T1 and Figure 4.4 for T2.

> "*Using real time data collection in* [redacted] *University Library to give students personalised recommendations on available study spaces, with forecasting for future occupancy levels.*" - Taken from the press release of T1

> "[redacted] *University Library Launches A New Feature That Helps Students Find A Desk That Is Right For Them*" - Taken from the press release of T2

The designs below show T1's mock ups of how a real time monitoring of library occupancy could be made available to students.

The participants on this table decided to add a feature to the existing 'Library' icon in the university's mobile application.

T2, also followed the path of designing an app, but it was not clear where this app would sit. This team focused less on occupancy, and more on finding personalised space, such as with a comfortable temperature or light level, and included routing to assist users in finding the space that was right for them.

Despite their final designs having a number of similarities, the number of ideas produced by each team was quite different. T1 generated 13 problems, which were then split into 11 categories and 65 solutions were generated. Whereas T2 generated 28 problems, which were then split into 5 categories and 41 solutions were generated.

4.1 Review of the workshop and methodology

The most interesting parts of this study, according to the observations made, were not those that were initially expected. The expectation was that the products and designs being created throughout the process were to be the artefacts used as data throughout

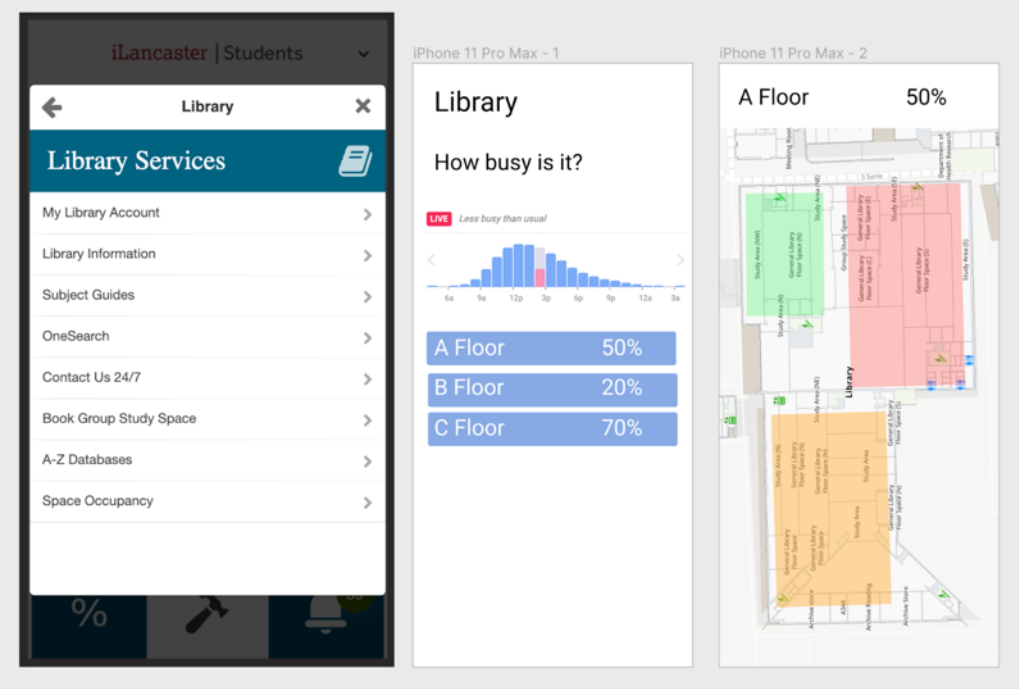

Figure 4.3: T1 designs from pilot study.

this thesis. Whereas upon observation, it became clear that the key decisions being made, were being made in the conversations being had between participants, and this informed the direction of the thesis going forwards. In this pilot study, these conversations despite being recorded had not been able to be transcribed as there were two groups working at the same time, so the conversations were indistinguishable from one another. This informed how other studies would be carried out going forwards: i.e. with one group running at a time. Section 4.2 discusses this in more detail.

4.2 Improvements for further studies

If the success of a pilot is measured in the learnings of what not to do, as opposed to what went well, then this pilot should be labelled as a success. Although no observations regarding characteristics and gender were made in a way that could be indicative of anything, mainly due to sample size and field notes being the main way the session was recorded, the pilot study enabled an deeper understanding of how the majority of the workshops in this work were to be run, as well as some limitations of the existing method.

Therefore, the following amendments were made to the workshops, in order to allow for more accurate observations and recordings, as well as the focus of the study

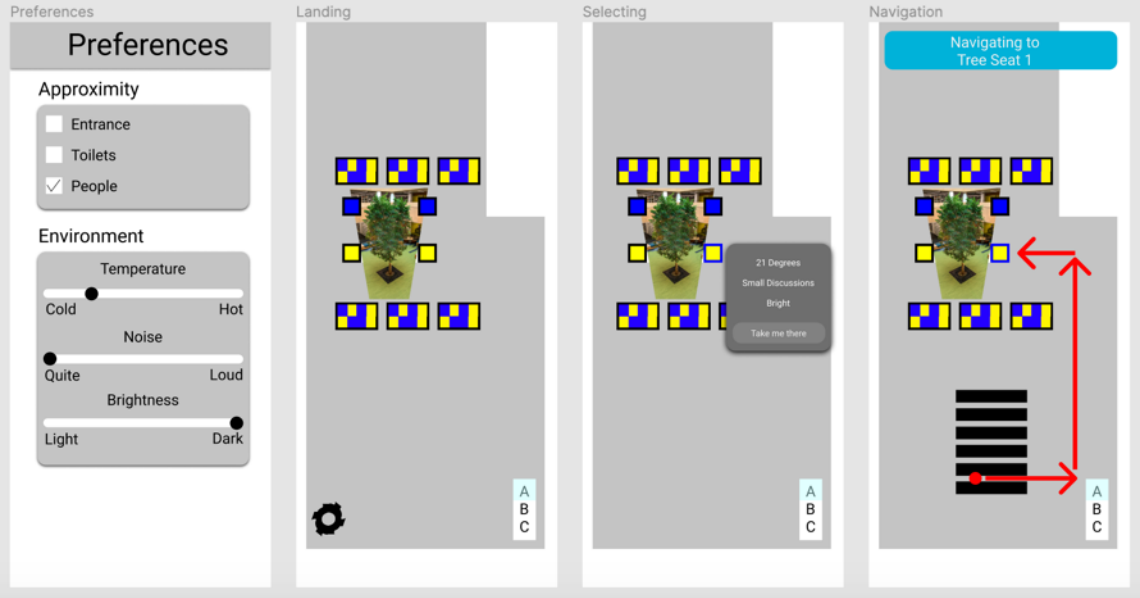

Figure 4.4: T2 designs from pilot study.

being placed on the conversations that took place, as opposed to the artifacts which were created. Further research, however, may include these artifacts, a significant output. However, how participants interact based on gender, and the way that they may feel affected by this, will be the primary focus moving forwards, and to enable this, the methodology will be adapted in the following ways.

- **One group** should be carried out at a time so recordings of conversations can be used, and the attention of the facilitator and researcher (as these are both this author) is not split between groups. This will allow for a more accurate analysis of conversation which is where it was observed most, if not all, decisions were made.
- **The timings should be adjusted**, less time for solo ideation, more for discussion, as again it appeared that this is where the value lay.
- **A survey should be carried out** prior to the running of workshops so that all identities of the participants can be known, to allow for a truly Intersectional Feminist Methodology to be carried out.

These adaptations are key to consider when considering **RQ2** which focuses on outlining which methods are the most insightful for uncovering factors that impact how design meetings are accomplished. What was brought forward in this study, is that it is the conversation that is key in progressing the design process, and that it

is this part of the design process which selected methods should explore in further studies.

4.3 Conclusion

It was clear from the running of this pilot that the conversations that take place should be recorded as this is where most decisions are made, and that this may be the most important part of the innovation process to understand in more depth. Furthermore, gender, and other characteristics should be acknowledged when making observations, e.g. roles within the organisation, language barriers or other characteristics such as race. Only by understanding the identities of those involved will any conclusions be able to be drawn from this. With these amendments, the first study (Chapter 5), will allow for a more appropriate methodology to be carried out, as well as a more detailed analysis, allowing for any potential gender differences to be uncovered and examined alongside existing literature.

Despite no in-depth analysis being able to be carried out due to only field notes being recorded and usable, the contributions from this pilot study led to much of the literature surrounding gender and conversation being carried out (Section 2.4.2).

Contributions of Chapter 4

- Observations and field notes identified the conversations (around decision making) as being a valuable direction for subsequent research.
- For audio quality, only one group should run at a time.
- Gender differences in the conversations were observed, and therefore require further investigation.
- A survey to uncover the identities of participants should be run, to ensure assumptions are not made.

Chapter 5

Student Workshops: I laid the groundwork.

Elements of this Chapter were published at OzChi in 2020 (Ashcroft, 2020a) and a statistical analysis published later (Ashcroft, 2020b), but amendments have been made in this thesis to expand upon areas, improve the published data analysis and add more clarification.

To explore the potential relationship between gendered language and CS design, Chapter 5 presents a case study examining an innovation workshop with seven university students (five women, two men) aimed at improving academic outcomes. Using a combination of Thematic and Conversation Analysis, the study uncovered notable gender differences in three key areas: problem raising (Section 5.3.1), language use (Section 5.3.2), and group practices (Section 5.3.3). For instance, men and women raised different problems; the women used more apologetic language; and gender roles emerged around writing and leadership. Although limited by its small sample size, these findings align with existing literature on gendered behaviours in group settings. Furthermore, they highlight the need for more research on how subtle language traits tied to gender identity may shape design conversations and decisions in CS. The implications prompt further investigation across various design contexts to develop equitable and inclusive practices. This Chapter lays the groundwork for the rest of the thesis in exploring these complex gender dynamics within design.

One of the propositions made in this Chapter, building upon the Literature Review (Chapter 2) and Methodologies (Chapter 3) outlined above, is to present a combination of Thematic Analysis and CA, allowing conversations and discussions to be analysed and the main topics to be examined in further detail. Building on fundamental principles from CA, such as turn-taking (Kitzinger, 2008) and language

used (E. H. Stokoe & Weatherall, 2002), as well as wider theories around language (Johnstone, 2018) this process will also enable themes outside of the conversation structure to be examined such as; the types of ideas being brought forward, the meaning of the language being used. However, this will also allow classic CA examples of group practices to be examined such as leading and turn-taking.

Furthermore, in this Chapter gender is inadvertently treated as a binary, as all participants self-identified as men or women, and much of the existing literature in this field draws on similar examples. The lack of full representation when it comes to the gender identity expressed in this research, due to the small sample size must be noted, particularly when it comes to generalisation, which is discussed in more detail below.

5.1 Methodology

The methodology of PD, has a set structure given that it is a research methodology (Spinuzzi, 2005). This three-stage method includes; "initial exploration of work", "discovery process" and "prototyping" (Spinuzzi, 2005). In this study of design, the method of "initial exploration" was in the form of an innovation workshop. Innovation Workshops are a style of focus group, where participants are encouraged to adopt an innovative and creative thinking style. In this particular case this included; independent ideation around problem areas, followed by collaborative grouping. The "discovery process" was done through independent ideation of solutions around those problem areas, with the "prototyping" being carried out by the group at large. Ideation, in this instance, refers to the process of noting ideas around a topic on a sticky note. Many innovation workshops are based around this method of ideation; the differences lie in the topics of ideation and how these are derived (Silverstein et al., 2013). Once again, this author was both the facilitator of the workshops run, as well as the researcher in this research.

In this Chapter, a combination of analysis methods outlined in Chapter 3 was applied to analyse the transcripts from an innovation session with a group of university students. The methods included Conversation Analysis (CA) to identify themes related to how concepts were discussed, and Thematic Analysis to uncover additional themes based on what was being discussed. By integrating these approaches, this research aimed to not only understand the interactions between participants but also to explore the subtle differences in language that could reveal gender-related patterns. This analysis allowed existing themes from CA to be incorporated, while also enabling the emergence of new themes through thematic analysis.

The group discussions within the workshops were transcribed; when the participants were presenting one another's problems to the group in pairs, and secondly when solutions to the problems were self-presented and the top three selected. Whilst

the final designs were collected, for the case of this Chapter, they will not be used.

Discussions from the workshop were transcribed and the three stage process of Thematic Conversation Analysis began by the transcripts being reviewed and the main themes selected; through the observation of repeated patterns and existing traits extracted from Conversation Analysis.

Firstly, the transcripts of the conversations were read, with attention paid to the lines that appeared significant. This initial step aimed to gain a comprehensive understanding of the conversation's content and context. **Lines of interest, that led to decisions being made, were noted.**

Subsequently, a second reading of the transcripts was conducted, during which each line was compared to a predefined list of themes derived from the principles of CA. These themes included elements such as turn-taking, interruptions, and other fundamental conversational features (Kitzinger, 2008; E. H. Stokoe & Weatherall, 2002). **Notations were made whenever any of these themes from CA were observable within the text.**

Finally, the notes from both readings were systematically organised and grouped into distinct categories or themes. This grouping allowed a nuanced analysis of the communication dynamics at play within the transcripts. These results were then categorised into three areas, as detailed below.

It is understood that thematic analysis involves "more involvement and interpretation from the researcher" (Guest et al., 2012). Such an approach clearly raises issues of reflexivity, and validity, and therefore generalisation of any results to a wider sample of the population, as discussed in Chapter 3.

5.2 Context

The study took place with seven university students, who took part in a workshop with the department who provide IT services to the University. Prior to the workshop, the students completed a basic diversity survey.

This survey allowed participants to disclose their gender identity, age and race outside of the study; although race and age were not analysed in this study, it may be interesting to see how these factors effect interactions at a later date. As well as this, a survey maybe a comfortable way of divulging information for participants, as falling into a bracket could be a much less personal way divulging who they are. However, in this analysis, we will be focusing solely on self-selected gender identity as the scope for diversity. The participants have been numerically ordered for anonymity P1-P7. P1, P2, P4, P5 and P7 identified as women, and P3 and P6 identified as men. Once again, the gender representation in this Chapter happens to be a binary, and this should be noted as a limitation of the study and for ease of reading, and with the understanding that gender is not binary, the following labels will be used with "-M"

indicating the participant identifies as a man, and "-W" indicating the participant identifies as a woman; P1-W, P2-W, P3-M, P4-W, P5-W, P6-M and P7-W. The participants selected their own seats on arrival, and were all undergraduate students, who had seemingly not met before. Age, race, and other socio-demographics were not collected for this study, and this was noted as a limitation in the analysis and therefore collected in further studies.

Firstly, in isolation, participants were asked to write down any problems they, or friends and peers, faced around their academic studies. In total 37 problems were raised. The participants were then asked to pair up and to explain their problems to each other, in preparation to present the problems their partners had raised to the rest of the group.

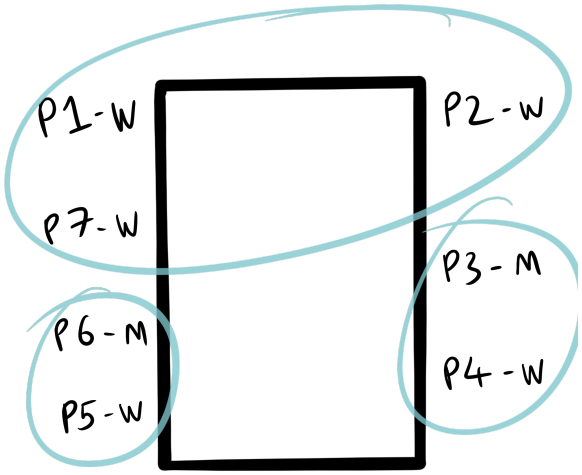

Figure 5.1: How participants chose to group themselves to share problems with one another for the 'Academic Outcome' workshop.

Figure 5.1 shows how the participants chose to 'pair up' to discuss their problems with one another. This made two mixed gender pairings, and one group with three women. After discussion between the smaller groups, they were then asked to present one another's problems to the rest of the group. P6-M went first, presenting P5-W's notes to the team. P3-M presented the problems of P4-W first. The group made up of all women, P7-W, P1-W and P2-W, had mixed all the sticky notes together and presented these as a group, each taking it turns to present the next sticky note that was picked up.

They were then asked as a team of seven, to categorise their problems into 'Problem Categories'. P7-W began writing out Problem Category headings, with

P6-M suggesting these titles. Once categories had been created, it was P7-W who suggested, "let's put these ideas by the categories and see if there's any left". They then worked in their original parings to place the sticky notes under each of the headings.

After categorising the 37 problems, the participants were then asked to individually ideate around the problems that had been raised. On completion, they were then asked to present their ideas to the team. They presented these clockwise around the table, starting with P4-W, a woman, after being asked by P3-M, a man, to start.

After each of the ideas had been read out, they were asked to pick the top three ideas. They did this by choosing the category that was important to the majority of the team. This discussion was led by P3-M. After this, they were asked to fill in a Business Canvas Model (Strategyzer, 2019) for each of the three ideas. They broke up into smaller groups again, unprompted, this time in the following format.

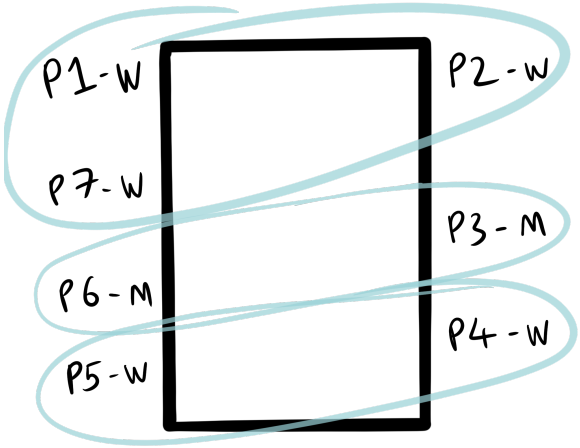

Figure 5.2: Participant's self-selected grouping for the completion of a business canvas model for their three top ideas.

The Business Model Canvas (Strategyzer, 2019) involves the expansion and further exploration of an idea (see Figure 5.3). This group ran as part of an innovation workshop at the University, where these completed canvases are used to inform business cases. Therefore, this was done to encourage the participants to think more in depth about their idea including what problems they were trying to solve, how the solution would work, as well as what makes their solution unique. The participants were then asked to select their top idea and complete designs for this. The top idea that was chosen was an improved timetable for students, with additional features.

Currently, the timetable system for the University only displays scheduled classes, exams and deadlines.

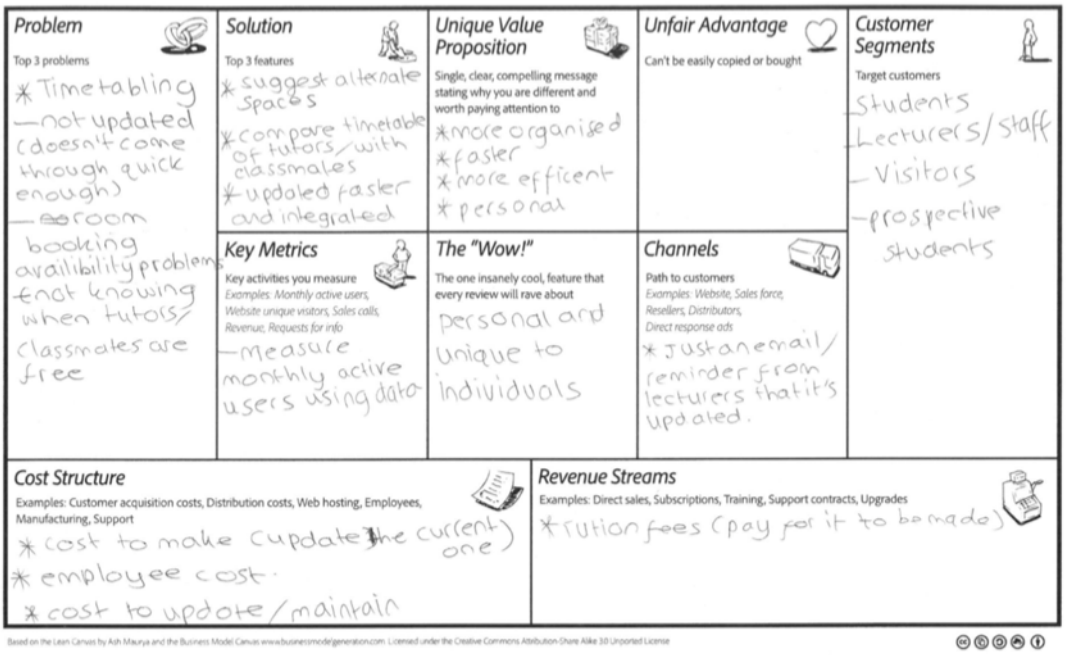

Figure 5.3: The final selected idea using the Business Model Canvas (Strategyzer, 2019).

The unique or 'wow' factor, as shown in Figure 5.3, for their new idea, was the ability to see when their friends, peers and tutors are free and to be able to book time with staff or peers directly, and to have all the University booking systems pull into their calendar or timetable so that their calendar is unique to them.

Figure 5.4 shows a centralised place for booking rooms and study spaces (the University currently has two systems for this, only one of which displays in the student timetable), as well as a way of booking appointments with their tutors. The participants all agreed (as can be seen in the lower right corner of Figure 5.4) that all events no matter how they are booked should display in their student timetable. Further research into the idea they selected and their designs could be carried out on this. However, the context of this study focuses on the process in which these designs were created, and the effect gender played on this.

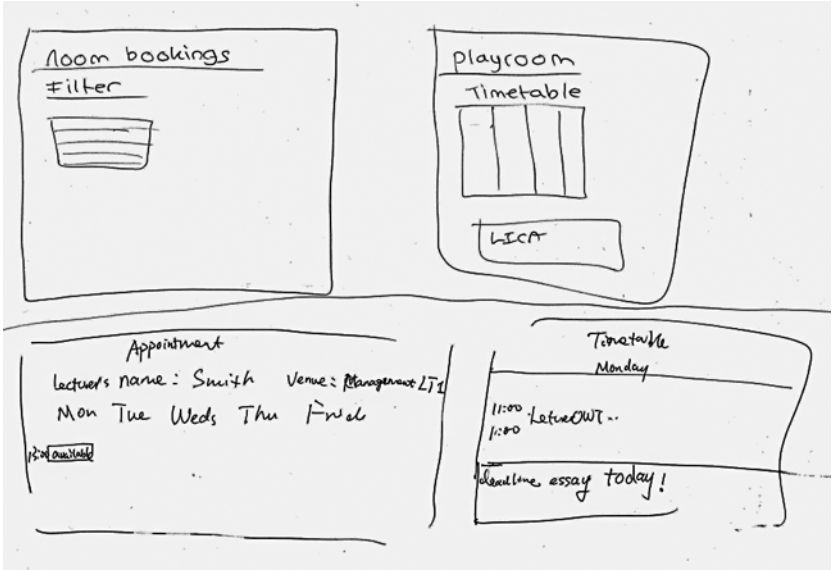

Figure 5.4: A subset of the final designs for the 'Academic Outcomes' workshop.

5.3 Results

In examining the data, the main themes found included; raising problems in a group (Section 5.3.1), the language and conversational styles used (Section 5.3.2) and finally the practicality of group working (Section 5.3.3). In this analysis, particular attention was given to how these were shaped by gender. These themes were found when in the conversations when participants shared and grouped their problems and solutions. The group was asked to pair up, with one group of three, and present one another's problems to the group. When the same was done for solutions, they were asked to present their own.

5.3.1 Problem Raising

The two men mainly raised issues to do with the University's academic practices and facilities, for example the keyboards not being suitable, whereas the five women raised more problems around the lifestyle of studying and how this fits into their lives, which can be seen below as P6-M presents P5-W's problem. This link between decision making, or the determination of what constitutes a problem, and gender is supported by Park (1996), who carried out a study which "statistically supported the argument that there exists a close relationship between gender role, decision style and leadership style."

When asked for problems, the men both presented solutions to their problems straight away, for example the suggestion of "better keyboards" as opposed to the

> **P6-M**: Oh and finding time to balance social life with school life, I don't know... time management... and all that kinds of stuff. Especially when you have times where like assignments assigned weeks before it's due and you have this thing going on in your mind and it's like basically if it's very, if it's like 50% of your grade, just be worrying about it for the whole... All this time, you cannot go to social stuff without worrying about it.
>
> Excerpt 5.1: P6-M presenting of P5-W's ideas.

problem being raised that the current keyboards are not fit for purpose.

> **P5-W**: Um, so, better keyboards would be really handy. Um, the resources in the library, so for textbooks you either have to use an e-book or buy one for yourself so it'd be more handy to have more copies available in the library.
>
> Excerpt 5.2: P5-W presenting of P3-M's ideas.

By presenting solutions before problems as requested this early in the process, then other ideas may not be brought forward by other individuals, in this case the women, as it was one of the men who voiced the solution first. Within design, it is important to first fully understand the problems that are trying to be solved before solutions are presented to ensure that any solutions are appropriate. Part of the design process is understanding the links between problems and creative solutions; therefore this study involves unpacking how gender effects each part of this process.

5.3.2 Language and Conversation

The language used by the participants throughout this process, with regards to apologising and asking for help, seemed to hold strong differences when it came to gender. These differences are explored in detail below.

5.3.2.1 Asking for Help

In the smaller grouping of P3-M and P4-W, they had opposite ways of asking for, or not asking for, help in explaining one another's ideas. P3-M read each of P4-W's problems from a sticky note and when they did not understand or trailed off, they simply declared "next one!" and moved on, as can be seen in Excerpt 5.3. Excerpt

5.3 also poses additional interest as P3-M does not ask P4-W for clarification they simply attempt to move on.They were then asked by the facilitator to explain further which P4-W then did.

P3-M: Um... Lecture recordings, um, she finds that helpful as well the lecture recordings. Lectures are meant to be fifty minutes in length, and many times she's found lecture recordings to be of a shorter length, for example forty minutes, so she, um, it disrupts her? Um, her ability to... um... yeah... Next one!
Facilitator: Sorry, just for that one, is that because lectures are shorter than they're meant to be, or because the lecture recording's been cut off?
P4-W: I think both.

Excerpt 5.3: P3-M is presenting P4-W's problems, is unclear on what she meant and attempts to change the subject, so the facilitator asks for clarification.

The aim of asking participants to present one another's problems to the rest of the group was to encourage the group to talk and work together, as these conversations were the most interesting in the previous study outlined in Chapter 4. In further research the role that gender plays on this could perhaps be considered with regards to empathy which may well be distributed differently by gender.

Later, when P4-W was presenting the problems of P3-M (see Excerpt 5.4), they admitted when they were unsure, saying to P3-M, "I forgot, can you say more about that?"

P4-W: Mmm... As in some TAs would just sit down, play with their phone, or they would, they have, um a lack of knowledge regarding the workshop materials, and then... Exam parameters... is unfair... So... I forgot, can you say more about that?
P3-M: Yes, so for example, um, um, for [department name], there was two problem actually. Number one, one of mine was put in such a way where you must complete this question before moving onto the next.

Excerpt 5.4: P4-W is presenting P3-M's problems, is unclear on what he meant and therefore asks him for clarification.

This presents a lot to uncover. The stereotype around men not admitting to

weakness (De Viggiani, 2012)[1] is supported in this behaviour. What is perhaps more interesting is the woman voicing her concern when she is unsure. Female students are two and a half times less likely to ask questions in academic seminars than their male counterparts (Carter et al., 2018). Whereas what was seen in this study contradicted this. However, again this is just one example, and therefore this would require a larger scale study to be carried out.

5.3.2.2 Hedging: Apologetic language and taking up space

After the group of three women had presented their problems, there was a pause and P1-Ws seemingly self-consciously said "we have a lot of problem[s]".

P1-W: We have a lot of problem.
Facilitator: There's three of you, there's gonna be... Excellent! Over to you guys[2]then... If you guys are done?
P1-W/2-W/7-W: Yeah, I think so.

Excerpt 5.5: P1-W ending by apologetically saying they had a lot of problems, and the conversation being turned to the next group.

The way in which problems were presented in both groups supports what Tannen (1994) observed in small mixed gender groups, where there were "far more women than men", "when it came to present small-group findings to the class, each group that included a man had chosen the man to stand up and be the spokesperson." As in both mixed pairings, it was the man who spoke first, as well as P1-W apologising for taking so long by saying "we have a lot of problem[s]". This indicates the behaviour of men to speak and 'take up space', whereas generally women prefer not to. Tannen (1994) also suggests that it is a manager's role to notice behaviour which silences women, and not for women to change their communication style. However, this could not be done in this setting as the facilitator would have impacted the research being carried out.

[1]De Viggiani (2012) present this research in a prison setting, so is not a direct comparison, but their research poses interesting ideas surrounding masculinity and sharing feelings of insecurity, reminiscent of the commercial non-fiction book by Caitlin Moran; 'What About Men?' (Moran, 2023)

[2]It also seems important, considering reflexivity, to acknowledge that this researcher who played the part of facilitator in the workshop, refers multiple times to the group as "guys", when the groups are either mixed or all women (see Excerpts 5.5 and 5.10). This author was also not aware of their own use of gender biased language until the transcripts were analysed. However, the focus of this study is the interactions between the participants, so this will not be explored further in this Chapter.

P4-W: Ok, I can go? Um, I have solutions, ok, I have three digital one[s] and one non-digital. The non-digital would be giving trainings for lectures, to lecturers. Because, er, to provide nicer material and for them to have better presentation skills. Because I feel like not all lecturers are, erm... What am I trying to say? I think some of them have side jobs, or even lecturing is their side jobs. So, I mean I'm not surprised that they're bad at lecturing, 'cause they just... but not, sorry...

Excerpt 5.6: P4-W apologising for being negative about the lecturers.

When presenting a solution around teaching (Excerpt 5.6), P4-W seemingly feels guilty for being negative by saying "because they just... but not... sorry...". This exemplifies the notion that women feel guilty for having an opposing view, supported by Adichie (2020) who states that "we teach girls to shrink themselves, to make themselves smaller", which can also be seen in Excerpt 5.4, where P4-W passes their turn to speak over to P3-M.

Excerpts 5.5, 5.6 and 5.3 all show examples of Hedging. For example in Excerpt 5.5 where the women say "I think so" when asked if they have completed their stack of post-its, when it's clear through observation that they have or in Excerpt 5.3, where P4-W says "I think both". P3-M can also be seen using Hedging in this excerpt too, through both questioning and trailing off; "it disrupts her? Um, her ability to... um... yeah...". Although P3-M's Hedging is in relation to his interpretation of a woman's idea which is also interesting. Whether these are personality traits or representative of gender differences would require further research; however, this small study contains many examples of this behaviour from women. This is supported by Murphy (2010) who states that "the use of hedges among females before a key word" is used "to avoid the appearance of playing the expert".

As outlined in the Literature Review (Chapter 2), Holmes (1986) suggests that Hedging has two purposes, either to express speaker confidence e.g. "you know" or "reflecting uncertainty" e.g. "I think". The subjective nature of Hedging could therefore be seen as a linguistic tool used by participants, not just as a means of interpretation. However, it is difficult to tell where Hedging is used deliberately, for example to seem more approachable, or when it used due to genuine uncertainty. For example, in Excerpt 5.5, when asked if they had completed going through their notes, the all-women group responded with "I think so", when it was clear that they had, as they'd moved all their sticky notes. Whereas in Excerpt 5.3, where P4-W says "I think both", they may not remember which of the two options they had been given, or they may be using Hedging as a tool so as not to cause any offence. This ties into

what Holmes later implies in 1990 in that context around Hedging is very important to consider (Holmes, 1990). What should be considered is the impact that this has on the decisions that are made throughout these conversations and any impact that this has on the designs being created, as well as the participants involved.

5.3.2.3 Hedging: Occurrences

From the transcripts, a list of "Hedging" terms were listed, categorised and contextualised for analysis. This was done using existing Hedging terms such as "I think", "you know" and "sort of" (Holmes, 1986, 1990; Murphy, 2010) and considering the importance of context (Gribanova & Gaidukova, 2019). Analysis was then carried out based on the number of occurrences of Hedging based on gender, considering the distribution of gender in the group, as well the context . As well as a basic numerical analysis on which terms were more popular with each gender, the context was then analysed in further detail, since the aim of this paper is to uncover exactly how Hedging is used differently between genders, not just how frequently. It should also be noted that these simple statistical tests were done as more of a litmus test for if this is something that could be done on a larger scale, and only shows areas of interest and conclusions should not be drawn from these alone.

The initial research carried out on the transcripts revealed many examples of Hedging. Table 5.1, below, shows the list of terms classified as "Hedging" terms (Holmes, 1986, 1990; Murphy, 2010) as well as "kind of" and "maybe" which this study chooses to define as Hedging terms. They were only recorded in the results when clearly used as Hedging, not in discussion. The "context" column refers to how they were used, be it to express uncertainty or to persuade the other participants or the facilitator (the categories were adapted from Holmes (1986) and Fraser (2010)). The average use per gender columns were calculated by dividing the number of uses by that gender by the number of participants of that gender to account for the uneven distribution (two men and five women).

Uses of "I think" were discounted when opinions were being discussed as this was a use of language and not a case of Hedging, as can be seen in Excerpts 5.7 and 5.8. An example of "I think" that was used as Hedging can be seen in Excerpt 5.8. Only counting Hedging is true in the case of other terms, e.g. "kinda", and they were only noted as a Hedging use if the context supported this. Cases of "um" and "er" have also been discounted as, although they were used frequently, they were used more by participants as a means of delay. This is exemplified in Excerpt 5.6 where P4-W struggles to find the words for something difficult.

As outlined in Section 3.4.5.5, a Mann-Whitney U Test was carried out, using the above code in R, on how Hedging was used on average between men and women and

Term	*Context*	*Uses by men*	*Uses by women*	*Average use of hedge per man*	*Average user of hedge per woman*
"I think"	Expressed uncer-tainty	3	14	**1.5**	**2.8**
"Kind of" or "kinda"	Expressed uncer-tainty	1	20	**0.5**	**4**
"Maybe"	Persuasion	5	5	**2.5**	**1**
"Sort of"	Expressed uncer-tainty	1	2	**0.5**	**0.4**
"You know" or "y'know"	Persuasion	2	4	**1**	**0.8**

Table 5.1: Occurrences of Hedging terms and their frequency of use by gender from the workshop, as well as an average to account for an uneven mix of gender in participants

gave a p value of 0.7526[3] which is higher than the standard significance level of 0.025 as it is a two tailed test, and therefore there is not sufficient evidence to reject the null hypothesis that there is a difference between the group of men and the group of women when it comes to Hedging. When the Mann-Whitney U Test is carried out using only the "expressing uncertainty" data (see Table 5.1) the p value comes out as 0.6579, once again not showing significance. When carried out for "persuasive" uses of Hedging, the p value is 0.4142, showing once again that there is no significance, even when it comes to the context of the Hedging. Looking at the averages in Table 5.1, significance was expected, but these results may be due to the small sample size or the fact that there was no difference, and further research should be done to uncover any potential differences in larger scale studies. This thesis does not present large scale data, but instead detailed case studies.

All the above results show a similar frequency of Hedging used by both male and female participants, and supports the findings by Dixon and Foster (1997), but contradicts the differences found by Holmes (1986). Of course the statistical analysis is impacted by the rather small sample and further workshops might provide further and more conclusive evidence. Clearly too there is a need to research some of the more contextual features of the various 'hedging' utterances through both observation

[3]The working for this cannot be shown as the R code is so simple, but it can be replicated easily using the right two columns of Table 5.1.

P3-M: So which do you guys think is the biggest problem?
P5-W: I think the library is probably one of the bigger problems.
P3-M: Ok
P5-W: So...
P3-M: What do you guys think?

Excerpt 5.7: An example of "I think" being discounted due to context.

P7-W:Um... Some lecturers don't use the interactive screen, so, um, so I think you want more people to use it... So...

Excerpt 5.8: An example of "I think" being used as Hedging.

and especially through interviewing[4] – "when you said 'maybe' here, what were you thinking? Why did you use that particular term?"

While Murphy (2010) states "the use of hedges among females" is used "to avoid the appearance of playing the expert". This analysis found no statistically significant gender differences in how Hedging was used. The data is interesting with the averages of "expressed uncertainty" being higher for women than men but they are not statistically significant. One issue may be that each occurrence of Hedging is being treated as equal, and a more subtle analysis of 'Hedging' is required to truly determine if there are any gender differences at play in group interaction in PD. The differences in past research (Dixon & Foster, 1997; Holmes, 1986; E. Stokoe & Smithson, 2001; E. H. Stokoe & Weatherall, 2002) show that this lack of statistically significant results may not be all it appears, in fact it could be suggested that it simply shows the need for a more subtle means of analysis. Perhaps using only two Hedging categories was not enough, or perhaps as Murphy (2010) and Fraser (2010) suggest, it is important to consider exactly where in an utterance a 'Hedging' term is used. Therefore, future research should include contextual analysis, which is applied in future chapters. Overall, this simple statistical analysis suggested that Hedging is a key area of research for the rest of this thesis, not least because of its implications for the process and value of design, the design of workshops and consideration of the

[4]This is not done throughout this research, as once industry settings were observed, the context differed to be much more positive (Chapter 7), but this could be carried in research beyond this thesis.

```
# Average uses of Hedging for the two groups
men <- c(1.5, 0.5, 2.5, 0.5, 1)
women <- c(2.8, 4, 1, 0.4, 0.8)

# Perform the Mann–Whitney U test
result <- wilcox.test(men, women)

# Print the test result
cprint(result)
```

Figure 5.5: R code used to carry out Mann-Whitney U Test

role of workshop facilitators in considering and regulating the effects of 'Hedging' in design discussions. If workshop facilitators learn to recognise the differential use of 'Hedging' terms by participants then they can respond in various ways and hopefully improve the value of workshop discussions, through acknowledging the importance of giving voice and parity, ensuring group dynamics and outcomes that properly reflect the views of all participants.

5.3.3 Group Practices

This Section (5.3.3) examines group practices during the innovation session, focusing on two aspects: writing roles (Section 5.3.3.1) and leading and turn-taking patterns (Section 5.3.3.2). P7-W, a woman, volunteered to be the scribe without group consensus, potentially reflecting gender biases and P3-M, a man, took the lead in selecting top ideas, exemplifying gender differences in leadership roles. These findings align with existing research on gender-specific behaviours in group settings, although leave room for a more subtle analysis in place of generalisations.

5.3.3.1 Writing: "I'll just do it."

P3-M asks the group "who's the best writer here?" and P7-W, a woman, responds "I'll just do it", to which P3-M, a man, laughs, see below in Excerpt 5.9. From this point on P7-W is the scribe for the group. P7-W does however use this where she can to influence what is written down.

In their role, as 'scribe', P7-W was able to write out category headings without the whole group's approval, and wrote these down and showed them to the other women sat nearby who confirmed their support of the work. This does suggest an element of

P5-W: The library can probably be one by itself.
P3-M: Yes, definitely.
P5-W: Who wants to write that?
P3-M: Who's the best writer here?
P7-W: I'll just do it.

Excerpt 5.9: The decision of who writes the category headings when categorising the problems.

power being given to the person writing.

Quast (2015), discusses that Richard Branson, founder of the Virgin Group strongly believes that it should be everyone who makes notes in a meeting, being quoted to say; "men shouldn't take over the note taking from women, everyone should be taking notes." Journalistic articles such as "Taking Notes Isn't 'Women's Work': What To Do When You're The Default Admin" (Forbes, 2013) show that being asked to take notes or take the role of 'scribe' is a consistent problem women are faced with. "We internalize ideas from our socialization," (Adichie, 2020) – if all that is ever presented to us is women as scribes, then we may not realise that we're reinforcing it through our actions.

However, what is perhaps more unusual in this instance, is that P7-W herself volunteered for this role. This could be argued as either they wanted this role, or they were reinforcing a gender bias of which they may have been unaware.

5.3.3.2 Leading and Turn-Taking

When all ideas had been presented, the participants were asked to select their top three ideas to work on further. P3-M, a man, took the lead saying, "Let's determine which is the biggest problem first? Then we will find a solution which is best fitted for that biggest problem." They were heavily supported by P5-W who repeatedly said "ok" after each leading statement by P3-M. P3-M then led the discussion and took people around the table counting votes; "ok, so two timetabling, two library. . . ". After the top three solutions had been decided on, P3-M then again took the lead suggesting the groups split up again, which they did based on what idea they voted for.

In 1974, Sacks et al. (1974) attempted "to characterise, in its simplest systematic form, the organisation of turn-taking for conversation, and to extract some of the interest of that organisation". One of the attributes of CA they found was transitions between speakers having "no gap and no overlap" were common and more significantly

to this research that "turn order is not fixed, but varies." What was found in this Chapter supports more recent theories of gender and turn-taking by Kitzinger (2008) in that gender plays a role in who speaks next. As although in this Chapter participants went around the table clockwise, who spoke next was led by one of the two men.

Reuben et al. (2012), state that men often achieve leadership roles regardless of past performance. They found "that women are selected to represent the group 33.3% less often than their abilities would suggest". This is exemplified in this study by P3-M consistently taking the lead and organising the group, see Excerpt 5.10. However, there are examples in the transcripts of women leading the conversation, for example in Excerpt 5.9 where P5-W asks "who wants to write that?"

Facilitator: It's just what is the most important to you guys?
P4-W: Maybe timetable then?
P7-W: I agree, um, so...
P3-M: Timetable as well then?
P7-W: Timetable, whether that's with classmates, with lecturers, I think...
P3-M: Ok.
P7-W: That would be useful...
P3-M: Ok, so two timetabling, two library...
P6-M: How about lecturing? Because we mentioned about lecturers recording or like or the lectures, so each area maybe that sort of thing...
P3-M: I agree with you on that, so how about I'm for lecture materials and lecture as well?

Excerpt 5.10: When choosing their top three ideas to take forward to the next stage, P3-M took charge of the group.

This gender difference when it comes to leadership was also found in previous research where, when groups were separated by gender, each of the all-men groups established a self-elected leader, and only one of the two women's groups chose a leader based on ability (Ashcroft, 2018). This also links into collaboration, and how this may be impacted by power dynamics. For example, the group containing all women had already grouped their problems, as shown in Figure 5.1, and therefore did not present one another's ideas but just the ones nearest to them.

Excerpt 5.11 could be interpreted in two ways; firstly, that they did not clearly listen to the instructions, or secondly they were more collaborative. A larger sample size would be needed to draw any conclusions on this.

P7-W: We kinda mixed up everyone's so...
Facilitator: That's ok, you can all just present random ones.
P7-W: This one's yours I think... And it says the check in system's not stable, like sometimes you could be in like... in like... that room and it'll say you're not there.

Excerpt 5.11: The all-women group when presenting problems, had mixed up their ideas.

5.4 Discussion

Participatory Design (PD) aims to give all stakeholders a role in the designing of a product, and this was also the aim in this study. When it comes to a student's academic studies, the context of the group in this trial, the makeup of a PD group should involve students of all backgrounds and genders. To not include a variety of participants is to strive for failure. However, even when a variety of students are selected, there are seemingly a range of gender differences which present themselves. Whether these are down to a group setting in general, or a design setting, remains to be uncovered. However, the above results (Section 5.4) do clearly show a pattern of differences when it comes to gender. The main themes of problem raising, language and group practices which emerged are indicative of some wider issues at large, but this Chapter aims to analyse these themes with regards to conversations that facilitate design.

E. Stokoe (2006) states that "interaction can be analysed in ways that reveal how gender categories are routinely occasioned to accomplish some action". Therefore, it is important to consider how gender roles or categories affect the actions of participants, for example when P7-W volunteered for the task of writing down category headings. Throughout this Chapter, details were unpicked which may normally have been missed. This Chapter suggests that combining the methodologies of TA with CA may be the most appropriate way of uncovering cases of gender affecting group work in design. What this prompts, is the need for an exploration on how this affects the designs themselves, which leads to further research beyond this thesis.

5.4.1 Themes Emerging for Further Exploration

The differences in the raising of problems, with the different types of problems being raised and how these are raised could be an example of gender differences at large. For example, the solution first approach that was demonstrated in this workshop by

the men participating could overshadow any ideas generated by others, which will not lead to a more diverse range of ideas. This could be addressed by putting something into place in the workshop design to stop solutions being raised until later in the process, perhaps with clearer instructions from the researcher.

The language and conversation differences between genders that were noted in this study align with previous research by Speer and Stokoe (2011) showing that conversation and gender are linked. This is also in line with the apologetic nature of speech by women and their lack of willingness to take up space due to the patriarchy in which they were raised (Tannen, 1994). However, what was observed around language was one of the women's unapologetic request for more information. It could be argued that often women are expected to remain silent and not ask for help when it is needed, and it was a perhaps surprising and optimistic act within this study.

As for group practices, including the woman who volunteered to write and the man who led the discussion and selection of the final ideas, there were strong gender differences. Mainstream media has commented upon this (Forbes, 2013) and this study (see Excerpt 5.9) shows an example of a woman acting as scribe for the group. In design workshops, this may be a barrier to the women being active participants in a group settings, as they're unable to fully engage due to the task of writing down, meaning it would be more difficult to raise their own thoughts and opinions. In contrast, this may also be an opportunity to hold power e.g. selecting what to write down and how. So that people are able to fully participate in the design process, software that takes notes could be used such as Otter.ai (2023).

With regards to turn-taking and leadership, this study showed a clear example of a man assuming a leadership role and taking the lead in the group activity. When it comes to participatory design, this could be seen as a real obstacle, as all stakeholders are supposed to have equal input into the product. Having in-equal input from all participants can cause complications and this should be led by a facilitator and the facilitator should not be imposing their view on the group. Which is why any participant assuming a leadership role could be seen as potentially problematic as they are extremely unlikely to represent all potential users of the product or service. Therefore, a man in this study assuming this role without prompting is indicative of wider issues at large when it comes to the role gender plays on design in practice. Considerations for design based on this include facilitator training, ensuring diverse representation and making sure everyone is heard. Facilitators should be equipped with the necessary skills to maintain impartiality and effectively manage group dynamics. This training enables them to guide discussions without imposing their own viewpoints, ensuring that all participants, regardless of any assumed leadership roles, can contribute equally and meaningfully. Secondly, to begin to mitigate the potential issues arising from a single individual assuming a leadership role, it is imperative to prioritise diversity among participants. Design teams should actively seek and involve

individuals from various demographic backgrounds, including gender, in the design process. If facilitators and team leaders are trained in how to make a space equitable in terms of conversation, then how this impacts design should be investigated.

5.4.2 Further Research

While this Chapter has brought forwards a number of challenges associated with gender dynamics in design processes, there remains areas for future research beyond the scope of this thesis, three of which are outlined below..

1. Innovative Note-Taking Strategies: Future research can delve into innovative note-taking strategies that can mitigate the influence of gendered language and power dynamics in design discussions. For instance, exploring the use of AI-driven transcription services (e.g. (Otter.ai, 2023)) or designating a dedicated note-taker outside of the design team may offer promising solutions. It is crucial to investigate who these strategies impact and in what ways, with a focus on their effectiveness in promoting equitable participation.

2. Leadership and Team Dynamics: Understanding the intricate relationships between leaders and design teams may also be investigated; for example, how leadership styles and dynamics within design teams affect the overall design process, particularly in the context of gender. Exploring how gender-related factors influence leadership behaviours and team interactions may provide valuable insights into designing more balanced and collaborative design environments in CS.

3. Development of Inclusive Design Toolkits and Guidelines: Building upon the findings of this thesis, future research can focus on the development of practical toolkits and guidelines for design teams and facilitators. Examples of these toolkits have proven useful in other contexts, such as in AI education (Smith et al., 2023). These resources may offer structured approaches for mitigating the impacts of gendered language and design biases. Exploring the effectiveness of such toolkits in promoting inclusive design practices and equitable participation is essential. Additionally, research could delve into the adaptability of these resources across various design contexts and industries, outside CS.

Although this thesis does not approach the three areas outlined below, and instead focuses on deepening the understanding of how gender dynamics may interact with conversation and the impact this has on CS design, it would be interesting to look at these areas beyond the scope of the thesis.

5.5 Conclusion

Overall, this study is indicative of the way gender plays a strong role in group dynamics with regards to innovation, and that a combination of thematic and conversation

analysis was an appropriate way of analysing this type of phenomenon. Despite its small sample size, there are too many similarities between the themes found in this workshop and existing literature to discount any findings. Subtle traces of gender conformity and divergence have been outlined in the Excerpts presented throughout this Chapter in this case study of this innovation workshop around academic life at University. This study also brings to light the importance of the facilitator ensuring that workshop participants are empowered and able to engage fully within participatory design groups.

Answering of **RQ1.1** (To what extent does gendered language and behaviour impact the accomplishment?), the above findings, on the differences displayed with regards to problem raising, apologetic language, asking for help, Hedging and group practices such as writing and turn-taking are all indicative of gender differences in group design processes. This ties back into the discussion around Hedging made above where it is important to recognise the position of the talk and to understand the context (Holmes, 1990), a key contribution towards answering **RQ3.2** (How is design impacted by concepts such as Hedging, interruptions, emotional labour and project work?). To deconstruct the effect gender has on this process, each of these areas must be taken and investigated in further detail in different contexts, outlined in the following Chapters of this thesis. Due to the small sample size, it is important to test if these issues would still hold when applied to a larger proportion of the population. This study does however stand as a strong foundation for this research and gives direction in where thought should be applied. For example, would apologetic language still be used in a business context[5]? Would turn-taking still happen by simply going around the table but without a leader, or would a woman step forwards and lead the design? And then depending on the outcome of this, what can be done to allow equality or equity in a group setting[6]? It is vital that these questions are looked into in further detail in more extensive research to ensure that design workshops are carried out in a way that is sensitive to all genders.

This Chapter has outlined how a combination of Conversation and Thematic Analysis, with an understanding of Feminist Methodologies can be used in order to uncover factors which impact how design is done. This is a fundamental part of this research, reflected in **RQ2** (What methods are the most insightful for uncovering factors that impact how design meetings are accomplished?).

There is, of course, the argument that differences allow strength, and by encouraging equity in a group setting, we do not wish to remove participant's individuality and personality to establish all participants as being 'the same', but simply to allow themselves to un-apologetically participate and put their ideas forward, in order for the design process to be successful and the strongest product

[5]See the case study in Chapter 7

[6]This is discussed in the Conclusion (Chapter 8).

recommendations to be proposed. The implications of this study give us an understanding as to how the participants contribute towards a design process and how this may be affected by gender. Secondly, it gives a grounding for further research towards the design of group design workshops and how they may be carried out considering what has been found here around participant interaction. Furthermore, it is vital that when carrying out inclusive design, that it is not just numbers that are looked at to ensure equal representation, although this is vital, but how when this is done these interactions take place. A much more subtle analysis is needed in order to uncover recommendations and interactions for facilitators to use and look out for, so that requirements phases of designs can be better informed, and stronger products designed.

Contributions of Chapter 5

- Gender dynamics observed in innovation workshops with students in a university setting, support existing literature around; problem raising, apologetic language, asking for help, Hedging and group practices such as writing and turn-taking.
- Context when counting Hedging terms should be carefully considered and there is not one universal list of Hedging terms. A broader and more detailed understanding of Hedging should be considered which may include additional categories.
- The implications of this Chapter on design, lead to the need for a deeper understanding of how gendered language traits affect how decisions in CS design are made.

Chapter 6

Going Online: Just one simple glimpse of relief.

Due to the Covid-19 pandemic, workshops were re-trialled online to consider if they were fit for purpose. This Chapter contains the findings of this study.

Literature from as far back as 2004 explores online focus groups (OFGs), how these can be run, and how they have benefits that in person workshops do not (Oringderff, 2004). In 2001, a paper titled 'designing and conducting virtual focus groups' suggests that moving to OFGs is the way that things are moving as technology advances (Sweet, 2001) and this prediction has been solidified further by the pandemic. Not only is it now a sometimes more convenient option, but due to Covid-19, and the timeline of the thesis, it was the only option for much of this thesis.

However, there may be disadvantages to running these workshops online as outlined in Section 2.6, with Oringderff (2004) stating that "several limitations exist in the area of group dynamics." One of these pertains to classic CA traits: the "lack of nonverbal cues [..] can have a negative effect, as offence may be taken more easily and meanings misconstrued" (Oringderff, 2004). This potential for miscommunication must carefully be considered, given the output of previous Chapters, especially when researching gender and conversation, as this may lead to participants feeling uncomfortable which would be an important ethical concern.

Since the pandemic began, there are now more and more papers emerging with how to move research online, one of which poses that online group interviews are significantly more appropriate to run online than online focus groups suggesting that they feel less intrusive and more convenient (Dodds & Hess, 2020). However, this raises the question of how these changes in interactions will affect designs in CS.

6.1 Going Online

The context of this study is regarding a University's mobile application, which is used by all Undergraduates and most Postgraduates. This app was released in 2011 and over the last twelve years has been developed and improved to support the student experience. In order to continually improve the app, workshops are regularly run around different themes and areas regarding the student experience in order to find out what should be added or improved in the University app. These workshops and focus groups have previously been run in person, but due to the COVID-19 pandemic, had to move to be online. This Chapter aims to uncover what effects these workshops being run online may have on the improvements and decisions made regarding the design of the University app. Although this workshop was run initially as a secondary pilot, to see if the same methods could be used for an online discussion, the findings showed that they could be. Therefore, the data from this study was used in the conclusions.

6.2 Methodology

The first stage of the workshops is problem ideation, which involves generating problems around a specific area. When the workshops ran in person, participants were asked to write down, individually, on sticky notes as many problems or issues as they could which relate to the workshop theme. In this study the theme is remote learning. Participants will then be asked to present their problems to the group, as they would have done had the workshop taken place in person.

Once all the problems have been created, participants are then asked to categorise their problems. When in person, this normally involved asking participants to come up with problem areas/categories as a team and then to sort all their problems under these categories, physically with the sticky notes. Now this is happening remotely, these categories will be achieved through discussion, and then shared to the call's chat for reference.

The next stage, involves consolidating ideas (as participants are working form the same list, sometimes they will have come up with similar ideas — so it is good to merge these, and flag as being popular) and then ranking them between "really helpful" and "would be nice". Instead of this being a physical activity with sticky notes, the focus was now on the discussion and participants will be asked to discuss each idea and then to select their top three.

When participants have selected their top three ideas, they will then be asked to design these. With an in person workshop, this stage would use a large sheet of shared paper, where all participants have a pen and start designing. An online group design tool was selected but due to delays in amendments to University ethics forms, to

move online, due to Covid this was not approved in time for this study[1]. Therefore, individual design will have to be carried out. Participants will each be given five minutes for each of the three ideas to draw on paper in front of them how they think this idea would work. Once the design has taken place, the participants will present their ideas to the group.

Online blogs posted during the pandemic (Fita, 2020) have suggested that break out rooms are a solution to help aid more focused discussion; however, many student-written publications (Whear, 2020) have written about their dislike for breakout rooms, so these will be avoided. Instead of having between six and ten participants per group, the aim was to have two to three participants. This allowed the discussion to be focused.

6.2.1 The Participants and The Context

One group with just two participants was carried out around the topic of online and blended learning. One of the participants was a white, English, 19-year-old student studying full time at the University, who identified as a man and heterosexual and chose not to disclose any disabilities. As they were the first to sign up they will be noted as P1-M. The other participant was white, English, and mature part-time student in her fifties who identified as a woman and as a lesbian and was very open about her disabilities. This person will be referred to as P2-W. The facilitator's initial 'A' will be used when referred to in speech. Once again, this author facilitated the workshop.

The workshop ran, as outlined above, to pilot how these groups could be run remotely and to what extent this effects the designs and changes that are implemented, and the topic of conversation was how their University experience has been effected by the new 'blended', a combination of in person and online, teaching model. The emphasis in this Chapter is how the process is affected by it being carried out online; it is the methodology that is being analysed here, not the results of the workshop, therefore the small sample size should not affect the results.

6.2.2 Methodology for Analysis

The analysis used in this methodology is that of a combination of Thematic and Conversation Analysis, as outlined in the Methodology Chapter (3) and used in Chapter 5, which allowed conversations to be analysed.

This study, however, is focusing more on how appropriate online is as a format as opposed to the output of the discussion itself. So the themes will be based around

[1]This is to say, this study **was** carried out with ethical approval. But approval was not given in time for an online tool to be utilised.

this; how CA themes are affected by the group running online, do any additional themes emerge in the transcripts, and is the methodology appropriate online.

The CA traits from literature that were looked for in the first stage of the Thematic Conversation Analysis were:

- Overlapping,
- Turn taking,
- Leading,
- Hedging,
- Sex differences in the language,
- How gender, and varying identities, are constructed.

The existing themes that were brought forward from Chapter 5 and searched for comprised of:

- Problem raising,
- Asking for help,
- Group Practices: e.g. writing.

The first stage of the analysis was noting where any of these existing themes occurred. It was also important to ensure that existing themes were not noted if they did not occur in the transcription. The second was noting any new areas of interest, particularly pertaining to the workshop running remotely (e.g. technical difficulties). The third stage of the analysis was grouping any noted lines of the transcript for presentation.

6.3 The Results

The aim of this Chapter, as stated above, is to uncover to what extent running the mobile design workshops online is appropriate. Two main areas were established using the above stages of analysis: running the workshop online (Section 6.3.1) and how the conversation took place (Section 6.3.2). The themes around talk that were noted and categorised into themes included: informality, a rushed ending, leading conversation, and problem raising. Only two of these themes came from the lists of existing themes brought forwards from CA literature and Chapter 5. This Section will outline these themes and give examples where appropriate.

6.3.1 Running the workshop online

Running these workshops online was a new experience as a facilitator and researcher, and it seems vital before looking at the results derived from the conversations that took place, to first look at the context in which they took place. This has been divided into 'technical difficulties' and a breakdown of the analysis when carried out on remote workshops.

6.3.1.1 Technical Difficulties

Firstly, it seems important to note that there were a number of technical difficulties in carrying out this workshop. Initially three people were meant to take part in this study, and one of them was unable to join due to "internet problems". Furthermore, there were some feedback issues caused by the computer of one of the participants, which was solved partway through when they used headphones.

Perhaps ironically, these technical difficulties were also raised by the participants in the problem ideation session, as the theme of the workshop was remote learning. Also, the way in which the invite was sent to them, a link to retain their anonymity as research participants until joining, as opposed to a meeting invite, was also raised as being confusing. But this was only seen in this way, according to the participant, because it was just different to how other staff around the University were planning online teaching and other sessions; and these inconsistencies were a large part of the discussions and a clear frustration of both participants. Looking forwards, the organiser should consider what can be done to assist participants in joining.

6.3.2 Themes emerged around the talk

This Section delves into the dynamics of conversation within the group, with a specific focus on the actions and contributions of individual participants. Notably, we discuss the unexpected deviation from conventional trends, where participant P2-W assumed a leadership role despite established research suggesting a different pattern.

Potential factors are explored, such as membership categorisation, which may have influenced these dynamics and highlight the relevance of these findings in the context of online workshops. While acknowledging the limited sample size, we emphasise the importance of this observation in shaping future research and the applicability of this methodology in online settings.

6.3.2.1 Informality

Perhaps due to the smaller number of people in the group, it seems that more open conversations were able to be had, and the feeling in the group was quite relaxed.

Both participants, for example, opened up about their mental health struggles since the University had switched to a blended learning model. Excerpts 6.1 - 6.4 are just a few examples of where mental health was discussed.

> **P2-W**: Yeah, I'm really concerned also about the lack of mental health support.
>
> Excerpt 6.1: An example of mental health being raised.

> **P2-W**: Yeah exactly, I did put in there that everybody in campus and off campus needs to have mental health first aid training.
>
> Excerpt 6.2: An example of mental health being raised.

> **P1-M**: mental health issues as well, I think it's gotten worse again recently
>
> Excerpt 6.3: An example of mental health being raised.

Further examples of informality can be seen in Excerpt 6.5 below. Throughout the workshop there was a level of teasing[2] and informality, which may have contributed to the overall transparency shown by the participants.

The openness and depth of discussions had seemed, anecdotally, to be much more intimate and honest than that of previously run workshops. This could of course be due to the fact that there were only two participants and the facilitator, but it could also be suggested to be related to the fact that this workshop ran remotely. Kennedy et al. (2021), for example, found post-Covid that "online co-design methods have also helped to break down some of the researcher–participant power imbalances and inequities traditionally noted in previous qualitative research". However, this informality could be key to encouraging openness and honesty from all participants in order to find out their actual behaviours and pain points, in order to develop and build a more useful app to the students.

[2]Past research has shown that teasing is linked to feeling comfortable (Slugoski & Turnbull, 1988; Sykes, 1966).

P2-W: This is really reassuring to me that I'm not the only person.

Excerpt 6.4: An example of mental health being raised.

A: Okay, so that was your final set then? So, what were they and if you had to rank them as well?
P2-W: Not asking for a lot are you A. Oh, I'm not sure I can rank round them, do you want to have a go at that P1-M?

Excerpt 6.5: An example of informality between participants and facilitator.

Furthermore, the more in depth conversations that were had, also lead to some areas of the workshop taking longer, which meant the UI design stage did not happen in this workshop.

6.3.2.2 Rushed Ending

As described in the methodology, when these workshops are run in person, one of the final stages is the physical design of the group's top three ideas; see Figure 6.1. Due to running out of time at the end of the workshop, as the discussions had taken longer; whether or not this was due to the workshops being run online or other variables would require more research, the designs themselves were not complete.

If these workshops were to continue online, then more time should be allocated to this step of the process. It may also be interesting to compare the outputs of the remote workshops against those of the in-person workshops beyond this thesis.

6.3.2.3 Leading

P2-W led most of the group activities and discussions once they had been set by the facilitator; excerpts 6.5 and 6.6 show examples of this. Past research has shown that more often than not, it is men who take the lead in groups (Ashcroft, 2018), and this group contradicted this trend. What may have been at play here is other membership categorisations (Boden, 1994) which can affect power dynamics, as P2-W was a mature student.

However, again due to the sample size, no conclusions should be drawn from this, it simply seemed worth highlighting due to its diversion from the trend; and more

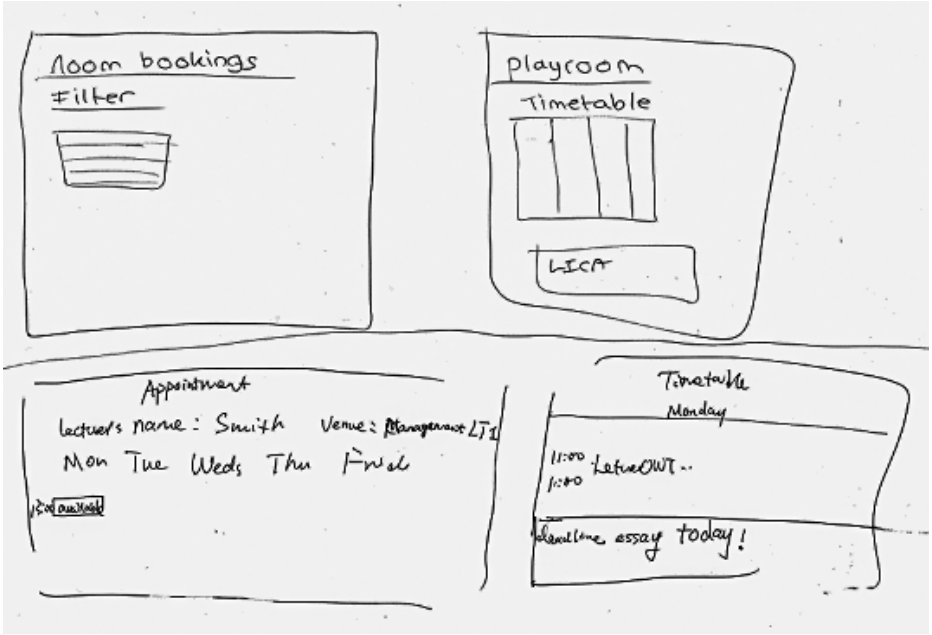

Figure 6.1: Design output taken from an in-person workshop before the pandemic.

P2-W: How did you get on with that, P1-M?

Excerpt 6.6: An example of the group leading themselves.

importantly, that this was still observable in an online meeting.

6.3.2.4 Problem and Idea Raising

Individual problem raising is one of the first stages of the workshop, in which individuals are given time to raise as many problems as they can think of in five minutes and then after to present these to the group. P1-M, wrote these ideas on a PowerPoint (a screenshot from later in the process can be seen in Figure 6.2), and then presented these to the group.

P2-W however, had written her problems down on a piece of paper and then verbally presented these to the group, and began her presentation by saying "yeah, some of this overlaps with what P1-M is saying and perhaps comes from a slightly different direction but the same issues." P2-W then read out her list of problems, and a discussion took place between the participants and the facilitator, regarding the combination of these problems.

The participants were then asked to categorise their problems, which normally happens as a group, but P2-W asked if they would be able to do the categorisation individually and then bring the categories together and merge them, as can be seen in Excerpt 6.7.

> **P2-W**: (Do) we have to chat about this, or could we have five minutes to see if we can bung them into buckets and then compare the buckets?
>
> Excerpt 6.7: P2-W checking the activity.

When it came to presenting their categories, once again each took a different approach, P1-M carried on using his presentation and used coloured categories, which can be seen in Figure 6.2, where yellow denotes "technology", blue "communication" and no highlighter means "health".

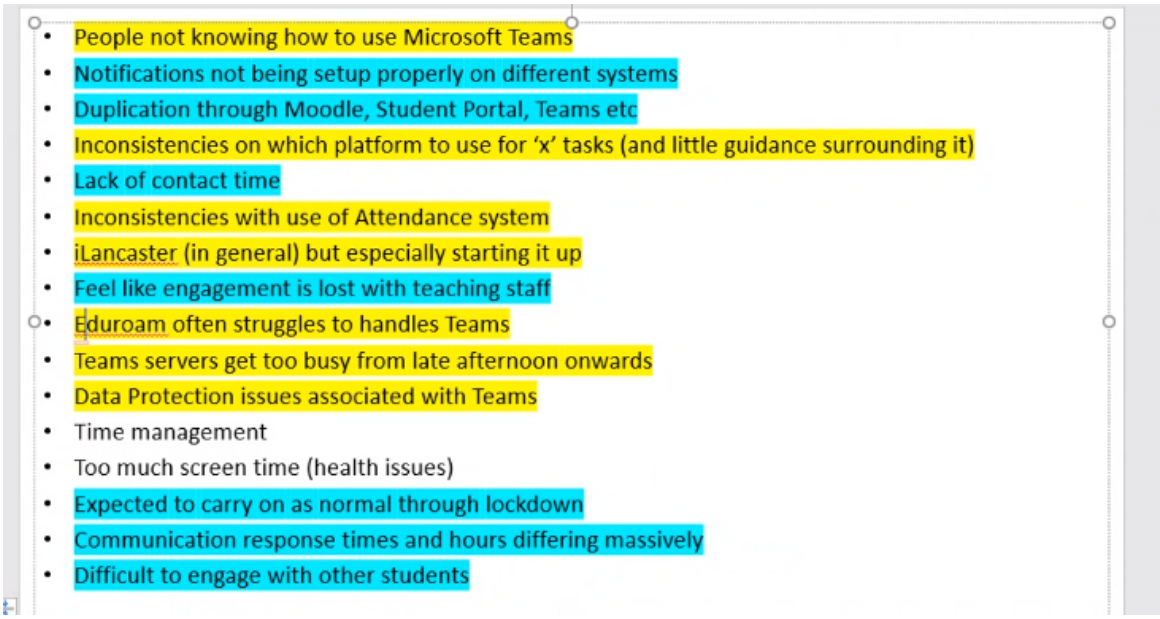

Figure 6.2: A screenshot of P1-M's categorisations of his problem areas.

P2-W then took the group through her categories verbally describing them and which problems would sit inside each of them, with her final categories being;

- Consistency of systems
- Consistency of usage

- Communications
- Value for money

When asked to combine their categories, they arrived at 2 main categories, each with subcategories, these final categories were:

- Technology
  - Experience
  - Consistency
- Student Experience
  - Tutor access and response
  - Facilitated collaborations
  - Mental health support
  - Communications

Both participants were then asked to ideate digital solutions to solve each of the problem areas. Unprompted, P1-M suggested that each participant took a category, but then they actually came up with their ideas through discussion.

Finally, the participants were asked for their top three ideas, and they presented four by P2-W. They were then asked to rank their ideas and more discussion took place. Their final ranked list of solutions were;

1. Regular interactive tutor communication
2. Mental health support
3. Facilitated student interaction
4. Consistent software set

The next phase of the workshop would have been to ask the participants to design these ideas and how they would fit into the University mobile application, but time had run out. Overall, interesting discussions were had around the issues of remote working, and the structure of the workshop did appear to follow a similar route to previously run workshops when they had been able to happen in person.

When looking at how problems are raised, past research has shown that men and women raise different types of problems in this type of workshop (Ashcroft, 2018), and differences can of course be seen here, although there were many cross overs; to quote P2-W in this online study, "yeah, some of this overlaps". These overlaps can be seen

more significantly when considering that there were only two main categories found for problems by the participants as seen above. The four ideas for solutions however, could be argued to be very interesting to take forward from this study and consider how the group would remotely design these to fit inside the app. Taking 'regular interactive tutor communication' as an example, would their design have been simply to book a meeting with their tutor in the app, or would it have been a live chat service or perhaps something entirely different? How 'creative' these ideas are, may also be effected by being remote, and perhaps the medium in which these remote workshops took place. Are the participants more likely to suggest video calls to solve the problem, simply because the workshop was done over a video call?

6.4 Considerations for Future Research

Overall this Chapter showed success in the process of app design moving to remote sessions, however there is still a lot to be done. It is clear that there must be a way of including the final stage of the process, the design of the ideas, and this may simply be a case of extending the workshop or shortening another area.

It would also be pertinent to look at how the informality and openness of the participants affects the designs being made (as discussed above), but also what the reason for this was. To look into if it was the participant's personalities, the online nature of the workshop or to uncover any other reason, as this did seem to open up the most discussion.

6.4.1 Can Thematic CA be carried out on these workshops?

In previously ran innovation workshops, a structured Thematic Conversation Analysis was carried out (Ashcroft, 2020a, 2020b) and allowed for an in-depth subtle analysis of the conversations taking place. This Chapter suggests that when these workshops run online, that this method of analysis seems just as appropriate, which contributes towards answering **RQ2** (What methods are the most insightful for uncovering factors that impact how design meetings are accomplished?). It could even be argued that the conversations being recorded with video remotely, could even allow for the discussions to be examined more closely as faces are all visible on the recordings.

In contrast, however, it is important to consider how CA has been designed for in person conversations with breaks, and turn taking and every detail of the conversation being examined. With the need for digital 'hand raising,' to avoid speaking over one another, which was used on multiple occasions throughout this workshop, it will also be vital to consider how this different style of conversation will affect both the research and the designs being created.

6.4.2 Study Evaluation

Despite the small sample size of this study, the workshop yielded some very interesting results about how the dynamics in a workshop may change by them being run online, but how these online groups still hold value. Although there were technical difficulties that prevented one participant from joining, the discussions that took place raised a large number of problems the students were having, as well as allowing for a discussion to happen around what the effects of these problems were and how they might be resolved. Furthermore, the informality of the workshop suggests that the online format may have allowed for more problems to be brought forwards than if the workshop had run face to face, e.g. those related to mental health. What can be concluded from this study is that problems were raised, categorised, and solutions ideated; which has been the aim of these workshops in order to improve the University's mobile application for many years. Therefore, it can be concluded that running these workshops online is an appropriate methodology, and they encourage innovative thinking just as much as those which are run in person.

Ørngreen and Levinsen (2017) consider "three workshop perspectives: workshops as a means, workshops as practice, and workshops as a research methodology" , and conclude that each of these workshop perspectives can yield different results, whilst each posing different difficulties. This same logic could be applied to the differences in running in-person and remote design groups. It would be easy to assume that by removing the face-to-face contact from a workshop, that something is lost. But it could also be considered that there is much to gain; for example, there are additional features such as 'hand raising' in most video conferencing software and there are textual chat functions, that can also be used. This Chapter suggests that on balance, the methodology developed throughout this thesis, is also appropriate for use on online meetings. It cannot be assumed that when conversations move online that the discussions which take place are any less valid (Tolmie et al., 2018), although it is important to consider that the role of the researcher and facilitator will change (Ørngreen & Levinsen, 2017).

This Chapter concludes that is it possible to continue innovation and CS design involving users in a remote setting, and that a dynamic between gender, language and how the work moves forwards is still observable online. Notwithstanding the small sample size, the observations made and analysis carried out shows that the discussions taking place still hold value in the process of designing a mobile application with its users, for its users.

Contributions of Chapter 6

- Technical difficulties are more likely to occur when groups are run online, and if further online workshops are to run, they should be sent as meeting invites and not as links.
- The workshop seemed to run more informally, but this is difficult to tell if this is because it was online, or due to the participants' personalities.
- A dynamic between gender, language and how design moves forwards is still observable online.

Chapter 7

The Real World: Just like clockwork, the dominoes cascaded in a line...

Hans: I mean it's crazy...
Anna: What?
Hans: We finish each other's...
Anna: Sandwiches!
Hans: That's what I was gonna say!

Frozen - Love Is An Open Door

Although gender differences were found within the running of innovation groups in Chapters 4 and 5, the small sample sizes and the student-based setting in which these workshops took place could be argued, based out the output of this Chapter, to be non-representative of how gender truly affects design decisions in the workplace. This led to the decision for the data to be gathered from design teams at various companies and organisations where real meetings could be observed, video recorded, and analysed. Of many companies that were approached, only one within the CS sector agreed to take part.

The company which took part, and is used as a case study within this chapter, was one that developed custom Natural Language Processing (NLP) software to be used within the marketing sector. This Chapter breaks down the context of this case study (Section 7.1), how the meetings were analysed (Section 7.2), what the results and analysis of these meetings showed (Sections 7.3 and 7.4) and the conclusions drawn from this.

Implementing the Thematic Conversation Analysis gave further examples of the gendered differences in language seen in the workshops. One of the three recorded

meetings, used in this Chapter, showed discussion of how topics of gender and sexuality were to be modelled within the development, which enabled a meta analysis of how these discussions took place and how a decision was made.

The main outcome of this case study was that of the subtle observations of emotional labour carried out by all participants. Building on the work of Hochschild (2019) who observes the emotional labour of managing conversations and Boden (1994) who observes the way that business is done through talk, this Chapter offers a analysis and example of this in CS. The contrast between the groups in an academic setting and observing a 'real-world' development team allows opportunity to see how work getting done differs or has similarities in each setting.

7.1 Context

The company used in this case study developed NLP software to assist marketers; this software was designed and developed in house. The team that opted to take part in the research was the Data Science team specialising in NLP. Over the course of a month, three meetings were recorded by the team and sent over to be used in the study, meaning that this author was not in attendance at the meeting. As it was the responsibility of the attendees to record the meeting, however, this meant that not every meeting in this time frame was recorded as it relied on the team to remember to record the meeting, but it may have potentially allowed the meetings to occur more naturally than if they had been more obviously observed[1]. This is reminiscent of existing research regarding reflexivity (Rode, 2011b).

The meetings took part over Zoom, as although many of the team worked from the same office, the company operates under a flexible working policy that allows employees to work from home. The meetings were made up of up to the same four participants, sometimes with more than one participant joining from the same device (those who were physically in the office that day). The meetings varied in length from approximately 10 to 30 minutes, and were how the team stayed in touch with each other on their progress to keep the project on track, also referred to as "daily stand ups," a practice adopted from Agile working practices (Agile Alliance, 2020). Procter et al. (2011) speak of the importance of these updates being shared to keep the project on track but also alluded to this being a form of micro management. The meetings used in this study consisted of each participant giving an update on what they were going to be working on in the upcoming day.

Each meeting began with the team greeting one another or, for example in Excerpt 7.1, the team talk about a video game before beginning to share the work they have

[1] All participants did, of course, know that the meetings were being recorded and had all signed ethical consent forms.

been doing and will be doing, and then go on to joke with each other about operating systems. This seems to be standard practice both from personal experience in these teams and existing literature, e.g. "the daily Skype chat usually begins with greetings and social chat, and then goes into the main topic" (Procter et al., 2011). The team in this case study then each took it in turns to give updates on what they had been and would be working on, shown in Excerpt 7.2 and offering each other help where needed (see Excerpt 7.3).

P1-M-TL: Just learned Russian before Elder Scrolls, five..? No, I guess Elder Scrolls online is five. Okay. Number six.
P2-W: No, five is Skyrim.
P3-M: Yeah.
P3-M & P4-M: Five is Skyrim.
P2-W: Then online is online and that's kinda out of numbering.

Excerpt 7.1: Chatting about learning languages to play video games and versions, before project updates begin.

P4-M: Um, so. My, uh, main project for at least the start of today is the data augmentation. I've been writing a program to take away as much of the work as possible while still having me check over to make sure it's not making strange columns.
P4-M: And, um, then then if I get all that labeled, then I'll train a model and write up the model card. Um, if not... If that's taking too long, I'll switch back to, um, analysis documentation.

Excerpt 7.2: A discussion about ongoing projects and plans.

One of the four participants self-identified as a woman, and the other three self-identified as men, one of whom was the team leader. All the men spoke English as a first language, and the woman spoke English fluently as a second language. It should be recognised that this may have an impact on the data, and therefore any results from this Chapter should be seen as indicative and generalisation should be avoided. This Chapter should, however, act as a template for how this research can be carried out, allowing for subtleties to be examined and understood when it comes to the gendered language of conversation in a software setting. In the case of this study,

P4-M: So, um, well one thing that's happening today is a lot of files are migrating to the laptop, um, which is being somewhat throttled by the terrible speed of USB three. But, um, on top of that, I'm looking to try and finish up all the analysis, analysis documentation, and, um, then from there, Depending on if VPN type things happen, I will either get the pipeline built or just have more files prepared for when the pipeline is built from here.
P1-M-TL: Cool. Um, if you have any questions about the pipeline stuff, let myself or [P2-W] know. Um, I'll be busy second half of the day.
(P4-M nods.)

Excerpt 7.3: Discussion about work and being offered help.

this author was not present for the recordings, and the team themselves recorded the meetings.

7.2 Methodology for Analysis

The meetings sent over by the team were transcribed, and once again analysed using a combination of Thematic Analysis and pulling in existing themes and knowledge from reading around Conversation Analysis and Chapters 5 and 6. This method of analysis had proved useful in previous studies (e.g. Chapter 6), and was therefore applied in this context too. Once again, Feminist Methodologies were applied, to ensure that gender was not simply an after thought, or as Harding (1987) calls it "adding women", but embedded throughout the research. This is vital to consider as identity is "intertwined in group dynamics" (Butler-Jones & Wintram, 1991) and can have a major impact on the way in which conversation takes place (E. Stokoe, 2004). Of course, it is not just gender that can impact language and conversation; but dynamics of power, which can be caused by race and other protected characteristics, and position (Boden, 1994), which is why considering Intersectionality is vital (S. Fox et al., 2017). Although, as stated by Butler-Jones and Wintram (1991), the different definitions of identity present a problem regarding which definitions of identity are used.

> "*If identity is intertwined with group dynamics, it presents us with a thorny problem. There are many definitions of identity, all potentially conflicting and derived from different schools of psychological thought, but all of which attempt to understand the same fundamental processes and phenomena, namely those characteristics which differentiate one person from another.*

> *As with any theoretical concept, the thorns are potentially damaging, their structure and components changing, depending upon whose definition of reality (or, in this case, identity) is being used.)*" - Butler-Jones and Wintram (1991).

The definitions of diversity (as discussed in Section 1.5.1) and membership categorisation (Boden, 1994) outlined in this Chapter is the same of that outlined throughout this thesis. Boden (1994)'s work on membership categorisation focuses on who has the right to talk or interrupt, and what is this and the talk accomplishing? However, one of the limitations of applying this into methods is there is an understanding that participants cannot be placed into finite boxes as each lived experience is unique, so an overview of some characteristics are given, but the focus of the research in this Chapter is mainly on how the interactions take place in this specific context.

Pseudonyms of Ps1, Ps2, Ps3, and Ps4 were given to the participants, based on the order in which they joined the first meetings. P1-M-TL was the team leader (-TL), and P2-W is the only woman in the team. Once again with the understanding of gender being non-binary, but the participants happening to be, signatures of "-M" and "-W" have been added to notations for ease.

Once again the transcription was not carried out in a strict CA style similar to that seen of E. Stokoe (2018), but a standard transcription was carried out so that Hedging and other gendered themes of language could be detected. Building upon the research and literature surveys of E. H. Stokoe and Weatherall (2002) and Sidnell (2010), the utilisation of Conversation Analysis (CA) as a means of evaluation has been extensively explored throughout this thesis. As E. Stokoe and Smithson (2001) emphasise, CA provides valuable tools for investigating how issues related to gender are occasioned in talk. However, while CA primarily focuses on the analysis of how things are said and the interactions between participants, this study aimed to examine the role of gender within a group setting concerning daily updates within a Data Science team. Therefore, in addition to understanding how interactions took place, it was essential to also focus on the content of what was being said. To fully grasp the intricacies of participants' interactions, it was important to comprehend the more subtle linguistic differences that may exist.

In this Chapter, similar to that of Chapters 5 and 6, the three stage analysis approach was applied. In this instance, a more comprehensive approach was taken by incorporating themes derived from both CA as well as the Thematic Analysis conducted in the earlier chapters:

- Overlapping,
- Turn taking,

- Leading,
- Hedging,
- Sex differences in the language,
- How gender, and varying identities, are constructed.

The first stage involved identifying and noting the previously identified themes within the transcripts to maintain continuity and note any recurring patterns. It was also important to ensure that these themes were only recorded if they appeared in the current transcription. The second stage allowed new areas of interest to be noted (e.g. 7.3.5). Lastly, the third stage entailed the grouping and categorisation of all the noted lines from the transcript.

As outlined in previous chapters, it is important to note that thematic analysis necessitates interpretation from the researcher (Guest et al., 2012). Such an approach raises issues of reflexivity, validity, and the generalisation of results to a broader population sample. This is why this Chapter must be approached merely as one example of a team carrying out meetings within this sector, and generalisation should be avoided.

A simple statistical analysis was carried out monitoring the uses of Hedging, in line with the methodologies adopted in Chapter 5, to discover once again if there was any statistical difference when it came to gender and Hedging. This involved counting occurrences of Hedging terms, such as "I think", "I guess" or "maybe", and separating these into circumstances of genuine Hedging, or a deliberate use of language. An average was then taken of both men and women as participants and a Mann-Whitney U test carried out. It must be noted, that the phrases detected as Hedging is very much down to this researcher's experience and understanding based on the tone of the speaker, and therefore should be used as indicative only.

In conclusion, this final data chapter employs a methodological framework that builds upon the earlier work of E. H. Stokoe and Weatherall (2002), Sidnell (2010), and E. Stokoe and Smithson (2001), combining Thematic Analysis and Conversation Analysis, with existing Feminist Methodologies. This integrated approach facilitates a comprehensive examination of the conversation, ensuring that both the nuances of linguistic patterns and the content of the discussion are captured effectively.

7.3 Results

The main themes which were found through the combination of thematic analysis and conversation analysis, included; overlapping (Section 7.3.1), turn taking (Section

7.3.2, Hedging (Section 7.3.3), support (Section 7.3.4) including active listening, and how LGBT+ and gender were discussed in the meetings (Section 7.3.5).

This Section maps out these characteristics and how they were observed within the three meetings' transcriptions. How these differed from the focus group settings, and any other notable differences, is explored in the analysis section (Section 7.4).

7.3.1 Overlapping

Building on the issues discovered in piloting online focus groups in Chapter 6, most of the overlaps seemed to be caused by the online nature of the meetings with issues such as lag or audio disruptions, as well as one instance of an external person from the team (but internal to the meeting) overhearing a part of the meeting and commenting on what was being discussed[2].

What was interesting about the way in which the team handled these overlaps, however, was their ability to apologise and quickly move on, as seen in Excerpt 7.4.

P2-W: Anyway, there's comments I'll say about it later.
P1-M-TL: Cool.
P3-M: Um...
P1-M-TL: Sorry, [P3-M], I interrupted you.
P3-M: Yeah, sure. Um, so I'm gonna be working on [project name] this morning.

Excerpt 7.4: An example of an interruption being acknowledged.

In this excerpt, P2-W, the only woman in the team, initiates the conversation, mentioning that they have comments to share later. P1-M-TL responds with a casual acknowledgment, demonstrating an understanding of P2-W's statement. Before P3-M can speak, P1-M-TL interrupts to apologise to P3-M for the interruption, indicating a respectful and considerate approach to communication. P3-M then continues with their update about working on a specific project. This is a clear example of an overlap, and not an interruption, as it was done accidentally, although other examples are often down to intention. This distinction outlined by Schegloff (2000), shows the first example of the way in which this team operate their business of talk. This example highlights the team's ability to manage interruptions and overlaps, regardless of their cause. The team members exhibit a strong sense of respect, empathy, and cooperation, enabling them to navigate such situations smoothly and with minimal disruption to

[2]This interruption has been redacted from the final transcript, as this person had not completed ethics forms to take part in the study.

the flow of the conversation. E. Stokoe (2018), states that overlap can be "an example of collaboration", and this can be seen through the very clear example of two team members finishing a sentence together (see Excerpt 7.5), when P1-M-TL (the leader who is a man) is talking and P2-W (the only woman in the team) guesses the end of the sentence and says it with them.

P1-M-TL: Yeah. And I guess if people are using it as an adverb that's very different than adjective. I mean, still as an adjective it can be. Like saying this road is very straight.
*(**P2-W** says "is very straight" at the same time as **P1-M-TL**.)*
P1-M-TL: Yeah, exactly. Um, but if you're saying go straight, then turn left. That's a different. Yeah, different one.
P2-W: Yeah.

Excerpt 7.5: Discussion on the different usage and implications of the word "straight" as an adverb and adjective.

Overall, the team's ability to address and overcome inevitable overlaps and interruptions exemplifies their professionalism and effective communication skills, creating a conducive and respectful atmosphere for meaningful discussions.

7.3.2 Turn taking

Turn taking, as a product of Conversation Analysis (E. Stokoe, 2018), exists wherever conversation with two or more people take place. In the context of these meetings, the order of speakers giving updates was self selected by the group through discussion.

The turn-taking dynamics within the meetings reflect an effort to maintain fairness and equality in the distribution of speaking opportunities. While the order of speakers giving updates may appear random, it is worth noting that the process of determining the order was discussed and considered. In Chapter 6 where the setting was a focus group setting, a seemingly random order of who spoke next was not actually the case (discussed further below in Section 7.4). A contrast between how who speaks next is decided, supports the work of Sacks et al. (1978) who states the importance of context when exploring how turns are taken, in short; "we have found reasons to take seriously the possibility that a characterisation of turn-taking organisation for conversation could be developed which would have the important twin feature of being context-free and capable of extraordinary context-sensitivity."

In Excerpt 7.6 there is the discussion of order and they decide to go in order of age, starting"with the youngest", and commenting on how the remote nature of

P1-M-TL: Right, anyways. Um, yeah, what's everyone up to today. What's happening? Who are we gonna start with today?
P4-M: There's no easy clockwise anymore.
P1-M-TL: No, there's not. There's not. Um, I'll start with the youngest. I'll start with [P4-M].

Excerpt 7.6: P1-M-TL starting the conversation.

P1-M-TL: Who's going next, [P4-M]?
P4-M: Oh. Decisions. Um, let's carry on with the next youngest theme and you can decide amongst yourselves who that is.

Excerpt 7.7: P4-M suggesting to continue with the next youngest person speaking.

the meeting has removed the option of simply going around the room. Excerpt 7.7 shows this decision being continued throughout this meeting. Other meetings show that there is no structure to who goes next, such as in Excerpt 7.12, where P3-M says, "Anybody wanna go first? I'll go first." Using Boden (1994)'s definition of turn-by-turn management, this would define these meetings as not formal, which is certainly seen in the attitude of the meetings, but does adhere to the content of a formal business meeting, suggesting that perhaps since 1994, the lines between formal and otherwise have blurred for inclusivity.

P2-W: I guess I can go next? Cool. So, um...
P2-W: I cleaned the multi comparison code and I push it to GitHub. So that's more or less closed down.
P1-M-TL: Woo!

Excerpt 7.8: P2-W volunteering to share their update next.

An example of deciding who speaks next can be seen in Excerpt 7.8, where P2-W volunteers to share her update next. By taking the initiative to offer their input, P2-W demonstrates a willingness to contribute and engage in the conversation. There seems to be no explicit gender difference in play here as this voluntary action, from an

attendee who is a woman, promotes a sense of agency and empowerment, suggesting that individuals have an equal opportunity to share their progress and ideas in this setting. Boden (1994) states that "turn-by-turn management is what marks these meetings as formal, rather than some factor external to the interaction". However, as stated above (Section 7.2, this case study cannot be used as an example to uphold the work of either Sacks et al. (1978) nor Power and Dal Martello (1986), but does supports the work of Boden (1994) who states that business itself is the context, and the context here is a development team updating one another on their work.

P2-W: Um, yeah, that's my Friday.
P1-M-TL: Cool.
P2-W: How about you, [P1-M-TL]?
P1-M-TL: Um, thanks for asking.
(everyone laughs)
P1-M-TL: Um...
P2-W: You're the last one!
P1-M-TL: Yeah, yeah.

Excerpt 7.9: P1-M-TL being prompted by P2-W to share, as the last person to speak.

A similar example can be seen in Excerpt 7.9, where P2-W specifically prompts P1-M-TL to share their update, recognising that P1-M-TL, despite being the leader, has not yet had an opportunity to contribute what they have been working on. This gesture highlights the awareness and consideration of ensuring that all participants have an equal chance to be heard. P2-W's comment, "You're the last one!", playfully draws attention to P1-M-TL's turn, reinforcing the equal distribution of speaking opportunities, as this was led by a team member, not the team leader.

How turns are taken in these meetings, suggest a conscious effort to create an inclusive and balanced conversational environment by all participants. By allowing individuals to volunteer or prompting those who have not spoken yet, the team members uphold a sense of fairness and equality in turn-taking. This practice seemingly ensures that everyone's input is valued and that no one dominates the conversation, fostering a collaborative and inclusive discussion and potential sense of belonging.

	P1-M-TL	P2-W	P3-M	P4-M
Meeting 1		1	2	1
Meeting 2	5	2		1
Meeting 3	2	6		

Table 7.1: Hedging terms by participant in each meeting.

	Hedging by men	Hedging by women	Hedging term used by a man but discounted	Hedging term used by a woman but discounted
Meeting 1	3	1	5	4
Meeting 2	6	2	1	0
Meeting 3	2	6	5	1
Sum	11	9	11	5

Table 7.2: Occurrences of Hedging across the three meetings transcribed.

7.3.3 Hedging

Despite being an overarching theme in the previous Chapters, Hedging does not appear to follow the same pattern in this case study. P1-M-TL, the team leader who identifies as a man, through observation seemed to employ Hedging more frequently than the other participants. Although when counted this was not the case, suggesting it was more about how these words were spoken as opposed to standard Hedging terms, e.g. "I think". To analyse if there was a difference in Hedging between men and women, as outlined in Section 3.4.5.5, counts of the participant's use of Hedging was broken down per meeting, as can be seen in Table 7.1. The discounted columns in Table 7.2 refers to when a Hedging term was found e.g. "I think", but the context inferred it was a genuine opinion, and not the expressing of uncertainty when there was not any. The results of the Mann-Whitney U Test, using the same code as in Figure 5.5 give a p value of 0.3687 which is higher than the standard significance level of 0.05 (0.025 for a two tailed test), and therefore there is not sufficient evidence to reject the null hypothesis. This observation raises intriguing possibilities regarding the role of Hedging in creating an environment that fosters inclusivity and support within the team, as explored further in Section 7.3.4.

The heightened occurrence of Hedging by all participants, however, and the use of it at all by P1-M-TL may be indicative of his deliberate efforts to create space for others to express their thoughts and perspectives. By using Hedging, P1-M-TL adopts a more tentative and cautious tone, allowing him to navigate the conversation with a sense of openness and receptiveness. This linguistic strategy can serve as a mechanism

	Hedging by all three men	Average per man	Hedging by one woman	Average per woman
Meeting 1	3	1	1	1
Meeting 2	6	2	2	2
Meeting 3	2	0.666666..	6	6

Table 7.3: Average of Hedging by men and women for each meeting.

for encouraging others to share their ideas, ensuring that diverse viewpoints are heard and valued within the team (Holmes, 1986, 1990; Murphy, 2010). P1-M-TL's use of Hedging may be an effective means of establishing a supportive atmosphere, where individuals feel comfortable expressing themselves without fear of judgement or dismissal.

Moreover, P1-M-TL's tendency to employ Hedging aligns with the broader findings of the study regarding the role of supportive behaviours within the team dynamics. As discussed in Section 7.3.4, creating a safe and inclusive space is crucial for fostering collaboration and ensuring that all team members feel valued and empowered to contribute. By acknowledging the inherent complexity of ideas and showing a willingness to consider diverse perspectives, P1-M-TL sets the tone for open dialogue and encourages a sense of mutual respect and understanding among the participants.

It is worth noting that the frequency and function of Hedging have been subjects of debate and varying interpretations in previous research. It was found in Chapter 5 that the frequency of Hedging usage did not show statistical significance between genders, which supports the findings of Dixon and Foster (1997). However, Holmes (1987) identified different functions of Hedging, such as "modal" (expressing certainty or otherwise) and "affective" (expressing politeness or reassurance) Hedging. Further research is required to conduct a more nuanced analysis of how Hedging is used differently, particularly within the context of group design and CS. The exploration of this particular study's use of Hedging found no statistically significant differences in the average frequency of Hedging between men and women, supporting the output of Chapter 5. Additionally, no significant gender-based differences were observed in the purposes of Hedging, although it should be noted that the sample size may have influenced the statistical analysis. Conducting future research with larger samples could provide further insights into how Hedging impacts group discussions and decisions, particularly as seen with this case study where it may have been used to increase collaboration.

7.3.4 Support

One of the most notable themes that surfaced during the analysis, revolved around how the team"support" one another. The analysis revealed numerous instances where the team leader actively extended support to team members, effectively positioning themselves as an equal and integral part of the team. These instances served as compelling examples of the leader's dedication to fostering an inclusive and supportive team dynamic, which is supported in existing literature. C.-W. Wang et al. (2009) cite much literature which has "shown the importance of leadership in group working processes" and go on to explore the "impact of motivating language on team members' creative performance", which has also been shown to be of even more importance when considering this from a global perspective (S. Chen et al., 2006).

In the Excerpt 7.10, we can observe P1-M-TL, the team leader, demonstrating their support for other team members in various ways. Firstly, during multiple meetings, P1-M-TL consistently displays active listening by utilising phrases such as "mm-hmm" or "yeah," which indicates their attentiveness and engagement. This not only encourages open communication but also fosters an environment where team members feel heard and valued (and is explored more in Section 7.3.4.1). Secondly, when team members told the team of their past work, P1-M-TL, the leader, showed enthusiastic support e.g. "Woo!" as seen in Excerpt 7.8.

Furthermore, in Excerpt 7.10, P1-M-TL explicitly acknowledges and validates the concerns raised by P3-M. By affirming, "yeah, that's, that's a valid, a valid concern," P1-M-TL ensures that P3-M's worries are recognised and respected. This example of an empathetic response not only helps to build trust within the team but also encourages a culture of open dialogue and collaboration.

Moreover, P1-M-TL refrains from downplaying the workload of their team member, instead acknowledging the intensity of their workload. Rather than dismissing it, P1-M-TL acknowledges the amount of work P3-M has to complete that day, remarking that their Friday appears to be quite busy. This recognition of the workload not only demonstrates P1-M-TL's understanding of the challenges faced by their team member but also emphasises their commitment to supporting them in their tasks.

By consistently employing active listening, validating concerns, and acknowledging workloads, P1-M-TL sets a positive example of supportive leadership within the team. These actions contribute to a cohesive and productive work environment where team members feel valued, respected, and supported in their professional endeavors.

7.3.4.1 Active listening

The support shown by the team is not reserved for one particular team member, the active listening is shown throughout each of the meetings transcribed, a further

P3-M: Um, then I'm gonna play around with, uh, Tableau a little bit later. Um, and then also today I've got to look through [other staff member]'s code.
P1-M-TL: Mm-hmm.
P3-M: Um, he built a model for the data source detection. Um, but he is a little bit worried that it's too good.
(everyone smirks)
P3-M: Um, so I'm gonna go through it and play around with it. Um, so that's a couple of hours as well.
P1-M-TL: Yeah, that's, that's a valid, a valid concern.
P3-M: Yeah.
(everyone laughs)
P3-M: Yeah, it's like, I think the accuracy is like 91% on some of the columns. It gets like 98 per cent accuracy. So, um, he's a little bit concerned about it cuz it's just really simple, um, diagrams model. Essentially that he's using. Um, so he is, he is a little bit worried, but we'll see. Yeah. Um, but yeah, that's me.
P1-M-TL: It's quite a busy Friday.

Excerpt 7.10: P1-M-TL validating the concerns and supporting P3-M.

example can be seen in Excerpt 7.16, where P1-M-TL actively listens and engages with P2-W's remarks on sexual identity and LGBT+ topics. P1-M-TL's use of phrases like "yeah" and "mm-hmm" showcases their attentive and empathetic approach to communication. Listening in both personal and professional settings is a well established area of research (Purdy & Borisoff, 1997) and how this is is shown can be, as displayed later in Excerpt 7.16, through verbal (and non-verbal) queues.

By actively listening and validating the concerns and ideas of team members, P1-M-TL fosters an inclusive and supportive environment, which supports existing literature positioning active listening as a business skill (Flynn et al., 2008) and has been described by Khanna (2020) as being "as crucial for healthy communication as critical thinking and problem solving ability". This approach potentially encourages open dialogue, promotes trust, and could empower team members to express themselves freely. P1-M-TL's commitment to active listening not only ensures that all voices are heard but also highlights their dedication to fairness and equal representation within team discussions.

It could also be suggested that the continuous support demonstrated by P1-M-TL goes beyond mere acknowledgment. By actively engaging in discussions and affirming the validity of team members' thoughts and concerns, for example commenting on the

P1-M-TL: So quite a lot today.
P2-W: Uh, probably sounds like more than today's. I mean, mainly knowledge graphs and a little bit of [inaudable section]. So like, it's not that much.

Excerpt 7.11: P1-M-TL and P2-W discussing P2-W's activities for the day.

"busy Friday" in Excerpt 7.10, or "quite a lot today" in an earlier meeting (shown in Excerpt 7.11)[3]. P1-M-TL also prompts the sharing of progress in jovial ways[4], as exemplified in Excerpt 7.12 through "how are you going to be enjoying this fine Friday?" P1-M-TL establishes a strong foundation for collaboration and teamwork. This supportive leadership style has the potential to foster a work environment where individuals feel valued, respected, and motivated to contribute their best efforts. The "busy Friday" example (Excerpt 7.10) also supports Boden (1994)'s example of closing a portion of speech through "solicitudes of "good health" or of "not working too heard" or "taking care of oneself"", as does the closing of the third meeting through P1-M-TL saying, "if I don't talk to you before the end of the day, have a, uh, very happy non-denominational four day bank holiday".

P1-M-TL: Right. Happy Friday everyone. It's nice and sunny, as you can see. (Leans to the side to show the window.)
P1-M-TL: Um, how are you going to be enjoying this Fine Friday?
P3-M: Anybody wanna go first? I'll go first.
P1-M-TL: Oh, I, I guess, I guess before you get started, just want to in person say that documentation
***P2-W**: was (gestures chefs kiss) well, great.*

Excerpt 7.12: Friday greetings, order discussion and compliments on documentation.

[3]Although despite P1-M-TL pointing out that this is a lot of work, P2-W describes it as "not that much", it is unclear which is true, or if this is an example of a woman downplaying their contributions, or a leader showing support of the team's work.

[4]Other examples of jovial exchanges can be seen throughout the transcripts, with sign offs spoken in humorous ways sometimes including "yeah, hopefully don't get Covid again" in response to "see you on Monday". This joking and winding up has often been shown to increase a sense of belonging, particularly amongst men (Nichols, 2018).

P1-M-TL's consistent display of active listening, illustrates their commitment to fostering a supportive and inclusive team dynamic, and suggests an element of emotional labour. As found by Procter et al. (2011), there is evidence of emotional labour of the project manager; "this affective layer of the dialogue reminds us that project manager is also a lived experience". By encouraging open communication, validating concerns, and promoting equal representation, P1-M-TL sets a positive example of effective leadership that cultivates a potential sense of belonging and productive work environment. In doing so they take on typically more "feminine" traits of language, but the affect of this is seemingly a work environment that allows work and the projects to be completed.

7.3.5 LGBT+ and Gender

During the third meeting, an unexpected but thought-provoking discussion emerged around gender and LGBT+ (Lesbian, Gay, Bisecual and Transgender) groups and how this should be modelled. This offered valuable insights into not only how gendered language may affect design, but how gender and LGBT+ mappings are being discussed and decided within software design.

Excerpt 7.13 shows the raising of the topic of LGBT+ occurring. The context of this is they refer to a conversation they had the previous day about how they should be mapping these topics in the language model they are building. This is of interest for two reasons; firstly, *how* they are talking about these issues (this is explored in Section 7.3.5.1), and secondly, *that* they are talking about them at all (which is explored in Section 7.3.5.2).

P2-W: Um, finishing up some [redacted framework] stuff like you were saying yesterday, looking into kind of just moving some of the ones from the LGBTQ+ topic to just maybe sexual identity or just like, 'cause we were talking about we don't just have like a sexuality sort of topic.
P1-M-TL: Maybe just moving them back.
P2-W: Yeah. So, um...
P1-M-TL: To be a little bit more general.
P2-W: Option that I quite like is what [P3-M] suggested is like words like straight and stuff would be, I guess not LGBT?
P1-M-TL: Yeah, yeah.

Excerpt 7.13: P2-W raising the categorisation and topics of gender and LGBT within the NLP model being built.

P2-W: Sexual identity and there would be LGBT, but it would be kind of like two equal topics. Yeah. Even though there, there's probably few words that I devoted particularly to non-LGBT.
P1-M-TL: Yeah.
P2-W: Still would kind of make it more fairer than like having these people and those in separate topics like...
P1-M-TL: Mm-hmm.

Excerpt 7.14: Discussion on categorising sexual identity and LGBT+ topics within the NLP model being built.

Excerpt 7.14 shows that P2-W is considering how these topics should be modelled, and, beyond this excerpt, the discussion develops into a commentary on how "bi" is not always referring to sexuality but can be a pre-fix of "bi-racial" too. Topics such as this within language modelling are well known as often words can have different meanings. However, the team go on to discuss how the models of sexual identity and gender should be modelled, with for example the "T" from "LGBT+" referring to gender with the remaining letters referring to sexual identity (part of this conversation can be seen in Excerpt 7.15).

P3-M: Um, yeah, I was gonna say gender and sexuality seems like two separate things.
P3-M: Uh, personally.
P2-W: Yeah. But then transgender is part of LGBT, isn't it?
P3-M: Yeah. Yes.
(an overlap of "hmms" and laughs)
P4-M: LGBT struggles. Um, so many things in terms of gender, gender, um, sexuality. Plurality and things. Yeah. So it's quite hard to find anything it would subcategorise from.
P1-M-TL: Yeah.
P1-M-TL: So maybe it's not the best idea to have it as a subcategory.

Excerpt 7.15: Discussion of how to categorise the "T" in "LGBT".

These excerpts demonstrate a respectful and nuanced conversation among the participants, revealing their recognition of the intricate nature of gender, sexuality, and LGBT+ topics. The team engages in thoughtful deliberation, discussing not only

the technical aspects of modeling these concepts but also the broader implications and potential implications of their decisions.

7.3.5.1 How LGBT+ Groups and Gender were discussed

As outlined above, the discussions of LGBT+ topics and gender identity were approached with respect, and once again the team engaged with active listening, and explaining their thoughts on the topics, even when they disagreed with what being said (as was seen in Excerpt 7.15).

P2-W: Sexual identity and there would be LGBT, but it would be kind of like two equal topics. Yeah. Even though there, there's probably few words that I devoted particularly to non LGBT.
P1-M-TL: Yeah.
P2-W: Still would kind of make it more fairer than like having these people and those in separate topics like...
P1-M-TL: Mm-hmm.
P2-W: Just going then, um, it was a bit of an awkward thing with was like B. 'Cause B can be 'bi' or whatever. Yeah. And at the moment it's in love, I think.
P1-M-TL: Yeah.

Excerpt 7.16: An example of active listening.

Furthermore, as the conversations progressed, it became evident that the team members hold a certain level of familiarity and cohesion. This is exemplified in Excerpt 7.5, where P1-M-TL and P2-W finish each other's sentences while discussing the different usage and implications of the word "straight." This synchrony in their communication suggests an understanding among the team members, enabling them to anticipate each other's thoughts and seamlessly contribute to the ongoing discussions. Such collaboration and interaction could be argued to be vital in ensuring that diverse perspectives are considered and incorporated into the decision-making process regarding the design and implementation of the model being discussed.

The team's ability to maintain respectful and constructive dialogue, coupled with their increasing level of cohesion, suggests a commitment to thoroughly addressing complex issues surrounding gender, sexuality, and LGBT+ representation within their software design. What should, however, be considered is why it was this team of four people who are making this decision.

7.3.5.2 Why LGBT+ Groups and Gender were discussed

The fact that LGBT+ and gender categorisation were discussed at all demands note. Firstly, the fact that the topic needed discussion and was done so in a respectful manner deserves recognition. Secondly, however, what should be considered is that it is these four team members who are deciding how these topics and categories are being modelled, which ties into larger issues surrounding Large Language Models (LLMs) (Carlini et al., 2021). With most Generative AI (GenAI), the arguably most notable being ChatGPT, operating on unexposed LLMs (Lu et al., 2023), perhaps the reason for the lack of transparency is that they have not been built in the most appropriate way.

The conversation which took place here, was respectful, however, the four participants, although seemingly well educated on the topics, are not experts in this field. This raises the question, of who should be deciding how this data is modelled?

There are arguments surrounding LLMs on whether or not they should be built to represent language as it is used, or how it should be used (Santurkar et al., 2023). This author believes that if the LLMs are being used to analyse language, they should be built to represent how it used, and if the LLMs are being used in a GenAI context and making text, they should be built how language *should* be used[5]. One of the issues with this, however, is who is to decide how language 'should' be used (Santurkar et al., 2023). This is reminiscent of the empirical vs normative argument, with empirical pertaining to the nature of the world how it is, and normative as to how is *should* be (Piattoni, 2010). However, how this all relates to this research is, should it be four team members deciding how topics as complex as these are modelled?

7.3.6 Project Work

The meetings analysed in this case study were part of an ongoing software development project within the company. As referenced throughout the chapter, the demands of project work shaped various aspects of team communication and collaboration. The recurring meetings served to provide status updates and align on the work being completed to move the project forward. This context bears repeating, as it may be the context which explains why the way in which conversation took place differed so greatly from that of the university workshops. For example, in Excerpt 7.2, P4-M outlines their plan to work on data augmentation and model training that day, contributing to the overall project goals. Similarly, in Excerpt 7.3, P1-M-TL offers help with pipeline development, directly facilitating project tasks and Excerpt 7.11 shows P1-M-TL acknowledging the amount of work P2-W has to do, keeping track

[5]Perhaps there are also cases where the type of model used may need to be selected, such as the examples shown by Deshpande et al. (2023) who prompted ChatGPT to write different statements in the 'style' of certain personas.

of project workload distribution, as well as ensuring the team know that P1-M-TL is aware of this.

Beyond task-related discussions, the meetings also involved significant emotional labour (Hochschild, 2019), especially from P1-M-TL, to maintain the team working together to get the project work complete. As noted by Procter et al. (2011), dialogue is an affective layer is a key part of project management, and Boden (1994) who references the way in which talk can facilitate a project moving forwards. P1-M-TL fostered an inclusive team environment through actions like active listening (Excerpt 7.16), validating concerns (Excerpt 7.10), and offering enthusiastic support (Excerpt 7.8). Such leadership is the perfect example of emotional labour being carried out to ensure progress. However, the "exploitation" that is often brought forwards when emotional labour is discussed (Müller, 2018), often refers to gender, and the exploitation of women's work. What is interesting about this specific case study is how it was the leader, who identifies as a man, carrying out the labour in this case. Furthermore, P1-M-TL's use of humour and casual check-ins (Excerpts 7.1 and 7.12) contributed to a positive team climate. This aligns with Procter et al. (2011)'s observations on project managers using informal language to build rapport.

While emotional labour has been shown to facilitate team collaboration in project work, some studies have found no direct relationship between emotional labour and software quality. For example, Günsel (2014) developed a model examining the links between emotional labour, team collaboration, and software quality. They hypothesised that emotional labour would positively predict software quality by enabling greater team collaboration. However, their results did not find a significant path between emotional labour and software quality. They suggested this may be because emotional labour facilitates collaboration but not necessarily task performance. Though their study did not establish a direct effect, Günsel (2014) proposed that the ability to express a wider range of emotions makes teams more collaborative. This aligns with the emotional labour demonstrated by P1-M-TL to maintain team cohesion. Overall, examining emotional processes remains crucial to understanding team dynamics in project work, even if effects on tangible outputs are indirect.

Overall, examining the meetings provides insights into the interpersonal processes through which project tasks are assigned, tracked, and completed within a supportive team environment. P1-M-TL's emotional labour facilitated focus on the tasks while maintaining morale, highlighting the complex nature of collaboration in project work.

7.4 Analysis

The findings of this case study present two prominent areas of analysis that warrant exploration. Firstly, they highlight the disparities between academic focus groups,

as explored in previous chapters, and a sample of industry meetings, suggesting that communication dynamics differ across these contexts. Secondly, this Chapter prompts an investigation into the potential factors underlying these observed differences.

When examining the occurrences of overlapping speech, turn-taking patterns, and the use of Hedging, a noticeable contrast emerges between academic focus groups, both online and in-person, and the three recorded meetings analysed in this case study. One notable distinction revolves around gender dynamics, as the gender-related variations observed in academic focus groups were not explicitly apparent within the context of these recorded meetings.

This discrepancy may be attributed to the unique demands and expectations of the business environment, which are not present in academia, as the project work to be done is significantly longer and has more of an impact on those involved. Keeping a project on track is a well established area of research (Button & Sharrock, 1996; Procter et al., 2011), and project work in CS has previously been linked to emotional labour regarding "those related to the developers' community and to quality of the software produced" (Serebrenik, 2017). Furthermore, emotional labour has been shown to be linked to gender, with women on average carrying a higher load (Erickson & Ritter, 2001; Mulholland, 2002). What this case study has shown an example of is a case where all three of these areas are seemingly linked, and therefore this suggests further research should be conducted to uncover if and how this is the case. If communication is how business is done (Boden, 1994), and with SE transforming from a stereotypically isolated field of work to a more collaborative one (Serebrenik, 2017), then how communication is impacted by gendered characteristics must be understood.

In the pursuit of success within the industry, effective communication becomes a honed and well-practiced skill that team members are expected to possess, which is reminiscent of Boden (1994)'s 'Business of Talk'. Here, Boden (1994) states that language in business is often informed by what will ""look good" retrospectively". Conversation also often reflects upon what has happened in the past in combination with "membership categorisation" as an outline of who is "in" and "out". The nature of business interactions often necessitates a level of proficiency in managing conversations[6], including turn-taking, active listening, and assertive yet respectful expression of ideas.

On the other hand, an alternative explanation and potential limitation of this study could be that the teams willing to allow a gender researcher to record their

[6]It is interesting to consider how this might impact those early on in their careers. Research done outside this thesis uncovered how some spaces made people felt they belonged or didn't (Widdicks et al., 2021), but what remains to be uncovered is how this ties into conversation and CS. Work on "unlocking the clubhouse" alludes to this (Margolis & Fisher, 2002), but it would be interesting further research to consider how this impacts new perspectives in CS design specifically.

meetings are more confident in their ability to foster an inclusive and equitable team culture, which ties into themes of reflexivity and emotional intelligence (Holmes, 2010). By granting access to their discussions, these teams potentially exhibit a higher level of awareness and commitment to creating an environment that encourages diverse perspectives, regardless of gender. This confidence in their team dynamics could manifest in more balanced and inclusive communication practices, as evidenced by the absence of significant gender-related differences in the analysed meetings.

The dynamics of the team are exemplified in the support P1-M-TL showed for their team (as discussed in 7.3.4), through validation, offering help and active listening. One notable aspect of P1-M-TL's support was the consistent validation of their team members' ideas and contributions. This contradicts, or perhaps simply displays an exception to existing work done by Sheridan (2007) who states that "listening is seen to be the prototypical female skill", but also admits that "not all women and men talk in the ways that are common among, and expected of, their gender". This could also suggest that leaders who display these listening skills seem to create environments which foster belonging. This was found to be true by the project manager used in the written example conducted by Procter et al. (2011), who also used terms such as "'exactly right', 'you're doing the right thing', 'gr8'" as a means of "team building and maintaining morale". This sense of belonging is vital when trying to attracts and retain women in a field such as computing (Lewis et al., 2017). In other STEM subjects, for example, such as Mathematics, women's sense of belonging affects both their desire to pursue the subject and their success (Good et al., 2012), and other research has shown emotional labour to be linked with well-being (for example job satisfaction and burnout) and also task performance (Serebrenik, 2017). By acknowledging and affirming the value of others' perspectives, P1-M-TL not only validated their team members' sense of belonging and worth but also encouraged their continued engagement and participation. This validation has the potential to instill a sense of confidence and empowerment within the team, which can ultimately contributes to enhanced collaboration and productivity as discussed by Graziotin and Fagerholm (2019). In addition to validation, P1-M-TL actively offered assistance and support to their team members. This willingness to provide guidance, share knowledge, and give practical help further exemplified their commitment to the team.

Finally, what unexpectedly came out of this case study, in addition to the divergence from the academic focus groups, was the discussion of LGBT+ and Gender topics themselves. That these topics were discussed in a respectful way shows that the team are capable of having nuanced conversations, but adds to the existing issues within the NLP sector, where the LLMs being built are seemingly being built by linguistics and developers, not subject experts, which can lead to harmful consequences in GenAI (Nozza et al., 2022; Weidinger et al., 2021). The importance of an in-depth understanding of these issues when the models are created cannot be

understated to overcome existing stereotypes (Dhingra et al., 2023).

7.5 Conclusion

In conclusion, this case study has provided examples of insights into the dynamics of communication within software design teams that should be explored and has revealed two significant areas for analysis. Firstly, it has highlighted the disparities between academic focus groups and industry meetings, indicating that communication dynamics differ across these contexts. Secondly, it has prompted an investigation into the potential factors underlying these observed differences.

RQ1 aims to uncover factors which are important in the production of project outcomes. This Chapter, by examining the occurrences of overlapping speech, turn-taking patterns, and the use of Hedging, contributes to RQ1 being answered by a contrast emerging between academic focus groups from previous chapters and the recorded meetings analysed in this case study. This discrepancy may be attributed to the unique demands and expectations of the business environment, where effective communication skills are essential for success. As businesses develop, team members are expected to possess honed conversational skills, including adept management of conversations, active listening, and assertive yet respectful expression of ideas. Historically, "western societies supported the concept that the ideal 'professional' is primarily rational and controls emotions", whereas emotions and their processes are now recognised to be an important part of business (Günsel, 2014). Furthermore, these emotions and the regulation of them within oneself and that of the team by the leader, has been demonstrated to be incredibly valuable throughout this case study, supporting the understandings of existing research by Button and Sharrock (1996), Procter et al. (2011), and Serebrenik (2017).

Alternatively, the absence of significant gender-related differences in the analysed meetings could be attributed to the teams' confidence in fostering an inclusive and equitable team culture. By granting access to their discussions, these teams demonstrate a higher level of awareness and commitment to creating an environment that encourages diverse perspectives, regardless of gender. In short: a self selecting sampling issue.

However, this still gave the opportunity to see that the support shown by P1-M-TL towards their team members exemplifies the significance of validation, assistance, and active listening in fostering a supportive team environment. P1-M-TL consistently validated their team members' ideas and contributions, affirming their value and fostering a sense of belonging. Additionally, P1-M-TL actively offered assistance and support, further highlighting their commitment to the team's success. As discussed above, this is an example of how a leader carrying out emotional labour to ensure the team's meeting of project goals can be observed to support existing literature

(Button & Sharrock, 1996; Günsel, 2014; Procter et al., 2011; Serebrenik, 2017). Often emotional labour can be viewed as exploitation particularly when it comes to gender (Müller, 2018), so what should be considered here, is what the consequences are when it is carried out by leaders who are men, such as is seen in this case study. When reflecting upon **RQ3** (What concepts appear to the be most useful for understanding the accomplishment of design in CS?), the case study presented in this Chapter, deviates from what was found in the University setting. In the academic examples given in previous chapters, it was the women carrying out the emotional labour, particularly with their uses of Hedging, but this was not shown in this case study. This requires further research to uncover the consequences on both the people involved and on the impact of the project from design through to product.

Furthermore, this case study unexpectedly brought forth discussions on LGBT+ and gender topics. The respectful manner in which these topics were approached by the team indicates their capability to engage in nuanced conversations. However, it also draws attention to the existing challenges within the NLP sector, where language models are often built by linguists and developers rather than subject experts, potentially leading to limitations in addressing these sensitive topics (Dhingra et al., 2023; Nozza et al., 2022; Weidinger et al., 2021).

Overall, this analysis emphasises the importance of considering the contextual differences and factors that influence communication dynamics within software design teams. By understanding these disparities and promoting inclusive communication practices, organisations can strive to create collaborative and supportive environments that encourage diverse perspectives and ultimately enhance productivity and innovation.

Moving forward, it is important to consider the implications for design of this research (**RQ4**). Future research should delve deeper into the specific communication strategies and practices employed by successful software design teams, taking into account the unique demands of the industry and the promotion of inclusive environments. Additionally, exploring the experiences and perspectives of individuals from marginalised groups within these contexts can provide valuable insights into addressing existing challenges and fostering greater diversity and inclusivity in the field.

Ultimately, by applying these findings and continuing to study and refine communication practices within software design teams, will enable opportunities for more effective collaboration, heightened creativity, and a more inclusive and equitable future for all team members involved.

Contributions of Chapter 7

- The case study revealed disparities in communication dynamics between academic focus groups and industry meetings, indicating context-specific variations.
- The analysis contrasted the occurrences of overlapping speech, turn-taking patterns, and Hedging use in academic focus groups and recorded meetings, identifying unique communication practices in the business environment.
- The absence of significant gender-related differences in the analysed meetings suggested the teams' commitment to fostering an inclusive and equitable team culture.
- The leadership approach of P1-M-TL demonstrated the significance of emotional labour, validation, assistance, and active listening in creating a supportive team environment, raising questions about the impact of emotional labour when carried out by male leaders.
- The case study unexpectedly brought forth discussions on LGBT+ and gender topics, highlighting challenges in addressing sensitive topics in NLP language models built by linguists and developers.
- The analysis emphasised the importance of considering contextual differences and factors influencing communication dynamics within software design teams to promote collaboration, productivity, and innovation.
- Future research should explore specific communication strategies employed by successful software design teams and the experiences of individuals from marginalised groups to foster inclusivity and diversity in the field.

Chapter 8

Conclusions: Is this the end of all the endings?

> Who knows if I never showed up what could've been?
> There goes the loudest woman this town has ever seen.
> I had a marvelous time ruinin' everything.
>
> Taylor Swift - The Last Great American Dynasty

Throughout this thesis, a series of chapters have been presented, each contributing findings and highlighting various aspects of communication dynamics within different contexts. In Chapter 4, the pilot study highlighted the importance of managing audio quality during group discussions and suggested the need for further investigation into potential gender differences. This led us to delve into innovation workshops within a university setting in Chapter 5, where we observed gender dynamics manifesting through language use and group practices. The implications of these observations for the design process emerged as a critical area for further examination. Additionally, in Chapter 5, an analysis of Hedging usage revealed no statistically significant gender differences, but the study's small sample size prompted the investigations of the implications of these findings for design processes. Then, due to the Covid-19 pandemic, no further workshops could happen in person, and an online approach needed to be taken. Therefore, in Chapter 6, an online workshop was run to uncover how technical difficulties and the online environment influenced workshop dynamics, reinforcing an understanding of gender-related patterns in idea generation. However, to gain a broader perspective, industry meetings in Chapter 7 were observed. The investigation into communication dynamics between academic focus groups and industry meetings uncovered context-specific variations and the significance of fostering inclusive team cultures. The leadership approach and emotional labour

demonstrated by the leader of the team in industry, offered intriguing insights into the impact of gender dynamics in such settings. Additionally, the case study unexpectedly sparked discussions on LGBT+ and gender topics, accentuating the need for more ethical and inclusive practices in natural language processing. Overall, these chapters have provided an exploration of communication dynamics within University settings and an industry software design team, with implications for fostering creativity, collaboration, and inclusivity in the future. This series of case studies, have led to the outlining of how to apply existing methodologies in a CS setting, and seeing examples that both support and contradict existing research when it comes to gendered language in CS.

This Chapter will outline the contributions made from the case studies presented in this thesis. Section 8.1, focuses on answering **RQ1** and shows the empirical contributions to the understanding of gender dynamics in group settings, Hedging in design workshops, and communication dynamics in software design teams. Section 8.2, focusing on **RQ2**, highlights how existing methodological frameworks can be applied within a CS setting to highlight new findings. Answering **RQ3**, Section 8.3, shared the conceptual contributions which highlight the need for not only equal representation in software development, but how simply having representation in the room is insufficient if diverse voices are not heard, respected, or given opportunities to speak, as gendered language traits, such as Hedging, can impact communication dynamics and perpetuate biases. The significance of this issue cannot be understated, as it directly affects the appropriateness and inclusivity of software and technology, emphasising the need for research and exploration of feminist methodologies within HCI, that allow for more subtle analysis. Finally, Section 8.4 highlights the significance of conversation in Computer Science design settings and the importance of a participatory design approach, answering question **RQ4**, taking into account diverse personalities and protected groups, fostering open communication and equal participation for successful design processes.

8.1 Empirical Contributions

Existing research regarding organisational conversation (or talk), gender and that of design meetings, suggest that these three areas should hold some weight once combined. The work of Boden (1994) on organisational 'talk' states that conversation is how business is carried out. The examples shown in Chapter 6 show that of a design meeting with students in a university setting. When *real* business was observed in Chapter 7, different results were found to be true when it comes to gender.

This thesis supports Boden (1994)'s work that business is done through 'talk', and this work suggests that this cannot be fabricated. In workshops run with students, as discussed in depth in Chapter 6, there were distinct differences when it came to

language use and how that differed by gender. This inferred an impact on the design of systems, as decisions are made through talk. However, what was then found in Chapter 7 was that the way in which conversation takes place in business, or at least the business from the case study, is less impacted by gender and examples were seen similar to those discussed by Boden (1994).

Boden (1994) discusses membership categorisation in terms of protected characteristics, and outlines how existing characteristics, relationships and power dynamics can impact on the business of talk; this is also found in work by E. Stokoe (2004) who found that gender impacts language and interactions. The patterns of overlapping, turn-taking, leading, Hedging, sex differences in the language and how gender is constructed are well established areas of linguistics, and what this thesis has presented is how this can be explored within a CS and design setting.

The exploration of the first research question (**RQ1 - What influence does gendered language have in the production of project meeting outcomes?**) outlines factors underlying successful CS design meetings. By investigating various group contexts, including innovation workshops (Chapter 5), Hedging in design workshops (Chapters 5 and 6), and communication dynamics in software teams (Chapter 7), the thesis addresses the diverse dimensions of this question. The empirical insights gathered underscore the pivotal role of communication dynamics and language use in shaping the outcomes of design meetings. It illuminates how the interplay of gendered language, behaviour, and power dynamics can influence the accomplishment of these meetings.

Delving further into the sub-question (**RQ1.1 - To what extent does gendered language and behaviour impact the accomplishment?**), the research exposes the impact of gendered language and behaviour on the accomplishment of CS design meetings: both to encourage collaboration (Chapter 7) and where it can stop participants fully engaging (Chapter 5). The findings underscore the intricate ways in which gender norms and linguistic traits like Hedging, turn-taking, and language styles intersect, shaping communication patterns and, in turn, design outcomes. The case studies outlined in this thesis demonstrates that such gender-related language practices are not merely incidental; they are fundamental elements that can influence decision-making, idea generation, and collaborative dynamics within the context of CS design meetings. This exploration highlights the need to recognise and address these gender dynamics to foster equitable participation and achieve more inclusive and successful design processes.

The empirical contributions of this thesis align closely with both **RQ1** and **RQ1.1**. Through the examination of various group settings, this thesis uncovers the multifaceted factors that underlie the success of CS design meetings, while also underscoring the pivotal role of gendered language and behaviour in shaping these outcomes. The University workshops showed examples of gendered language following

stereotypical patterns and how this affected how the work moved forwards, and the industry example showed how when expectations were not met, this led to a collaborative environment. The insights derived from these case studies not only enhance an understanding of communication dynamics within CS design but also emphasise the urgency of addressing gender-related language practices for fostering inclusive and successful design endeavours.

8.1.1 Gender Dynamics in Innovation Workshops

Chapter 5 of this dissertation delved into the role of gender in innovation workshops and its impact on group dynamics. Through the application of Conversation Analysis, the study shed light on the subtle traces of gender conformity within an innovation workshop conducted at a university and supported the work of Franklin (2013) who observes that the dynamics men and women have in a group setting do not allow for true equality. Despite the small sample size, the findings revealed consistent similarities between themes found in the workshop and existing literature, highlighting the significance of gender in this context and case study.

One notable finding was the identification of gender differences in various group design processes, such as problem raising, apologetic language, asking for help, Hedging, and group practices like writing and turn-taking. This supported the work of Kitzinger (2008), Lindqvist et al. (2019), and E. Stokoe (2004). These differences tied back into the discussion around Hedging, supporting Dixon and Foster (1997), Fraser (2010), Holmes (1986), and Murphy (2010), where it became essential to recognise the position of talk and understand the context, i.e. in a finite workshop or as part of an ongoing project like in industry, when deconstructing the effect of gender on the design process.

Additionally, Chapters 5 and 6 served as a foundation for the rest of the thesis and raised questions about gender issues regarding turn-taking without a leader, and the role of women in leading design processes. By informing this research and facilitators on gender interactions, the study's implications suggested ways to create inclusive design environments and improve the design process's requirements phases.

8.1.2 Hedging in Design Workshops

Chapter 5 also included an analysis of Hedging terms used during a design workshop to express uncertainty or persuasion. A list of Hedging terms, including "I think," "kind of," "maybe," "sort of," and "you know" was compiled, using existing research from Dixon and Foster (1997), Fraser (2010), Holmes (1986), and Murphy (2010), and analysed based on their context of use. The frequency of each Hedging term's usage was recorded for both the men and women participating respectively, and statistical

analysis was conducted to compare the average use of Hedging terms between gender identity.

The findings in Chapters 5 and 7 indicated that hedges such as "kind of" and "I think" were used more frequently by women to express uncertainty, although this difference was not statistically significant due to the small sample size. The study also explored whether the use or categorisation of Hedging varied between genders, but again, no significant differences were found. However, the study acknowledged the need for more contextual and nuanced analysis in future research to better understand how Hedging varies by gender or gender identity.

Furthermore, Chapter 7 explores how this may have a relationship with emotional labour. The work of Hochschild (2019) focuses on emotional labour in the service industry and how this is impacted and impacts the conversation that takes place between service giver and service receiver. What this thesis outlines is how this impacts other types of conversation and other membership categorisations as part of a design process. This thesis expands Hochschild (2019)'s definition of emotional labour to include Hedging. In Chapter 5, Hedging is used to avoid potential conflict, by participants not wanting to incorrectly express the ideas of others (e.g. Excerpt 5.4), or by women to timidly say they had too much to contribute (e.g. Excerpt 5.5). This is, by definition, supporting the work of Hochschild (2019) and raising another example of their work. This ties into an understanding of how conversation can be used to push forward a process (as explored in Section 2.1), and was shown in a different way in Chapter 7 where the leader, who identified as a man, used these Hedging terms to foster a different environment: one that supported the team members. This should also be seen as emotional labour being carried out in order to facilitate a conversation and work being done, and does not have to been as gendered in and of itself.

The implications of this research emphasise the importance of recognising and addressing the differential use of Hedging terms by participants in CS design. By understanding these communication patterns, facilitators can respond appropriately and ensure all participants' views are properly reflected, enhancing the value of workshop discussions and ensuring that everyone is not only present, but *heard*.

8.1.3 Communication Dynamics in Software Design Teams

The industry observations in Chapter 7 presented a case study that explored communication dynamics in software design teams, specifically comparing academic focus groups (explored previously in Chapters 5 and 6) and industry meetings. The findings revealed differences between these contexts, with gender-related variations observed in academic focus groups not explicitly apparent in the recorded industry meetings. This suggested that the business environment demands a higher level of

communication proficiency supporting the work of Boden (1994), which may lead to more balanced and inclusive communication practices.

The case study unexpectedly brought forth discussions on LGBT+ and gender topics, emphasising the importance of addressing these sensitive issues in the NLP sector when creating language models. This highlights the need for deeper understanding and consideration of these topics in language model construction (Dhingra et al., 2023; Nozza et al., 2022; Weidinger et al., 2021).

Furthermore, there are ongoing debates about Language Models (LLMs) and whether they should be built to represent language as it is used or how it should be used (Santurkar et al., 2023). If LLMs are used for analysing language, they should represent its usage, and if used in GenAI contexts for generating text, they should embody how language *should* be used (Santurkar et al., 2023). However, determining how language 'should' be used poses ethical challenges as it relates to empirical vs. normative perspectives (Piattoni, 2010). Considering these debates, it becomes crucial to involve diverse stakeholders, including marginalised groups, in the decision-making process of how language models are constructed and used. Future research should explore communication strategies employed by successful software design teams and delve deeper into the experiences of individuals from marginalised groups to promote inclusive language representation and model development (Deshpande et al., 2023).

8.1.4 Concluding the Empirical Contributions

In conclusion, this thesis makes empirical contributions to the understanding of gender dynamics in group settings, Hedging in design workshops, and communication dynamics in software design teams. The findings from each chapter highlight the complexities of gender-related phenomena and communication patterns within different contexts, offering valuable insights into the significance of gender in group interactions and language use.

Part of Chapter 5 focused on the analysis of Hedging in design workshops, compiling a list of Hedging terms and examining their usage based on context. Although no statistically significant differences in Hedging use between genders were found due to the small sample size, the study emphasised the need for more nuanced analysis in future research. The chapter underscored the importance of recognising and addressing differential use of Hedging terms by participants to ensure all viewpoints are properly reflected in design discussions.

Chapter 7 explored communication dynamics in software design teams by comparing the academic focus groups of Chapter 4. The findings revealed differences between these contexts, with gender-related variations observed in academic focus groups not explicitly apparent in industry meetings. This suggested that the business environment demands a higher level of communication proficiency, supporting the

idea that business is conducted through talk (Boden, 1994). Chapter 7 also unexpectedly raised discussions on LGBT+ and gender topics, highlighting the need for understanding and addressing these sensitive issues in language model construction.

Overall, this thesis contributes to the existing body of research on gender and language by applying methodologies (explored in Section 8.2) to explore these areas in the context of innovation workshops, design meetings, and software design teams. It underscores the importance of recognising and accommodating gender-related differences to promote inclusivity and equitable participation in group settings. Furthermore, it draws attention to the ethical considerations in gendered language in all areas of CS; including creating language models, and advocates for involving diverse stakeholders as design decisions are made. By combining these empirical contributions, this research provides valuable insights for fostering inclusive communication practices and designing group settings that embrace diverse perspectives in CS.

8.2 Methodological Contributions

Large proportions of this Section (8.2) informed much of a publication in 2022 (Ashcroft, 2022a), but amendments have been made in this thesis to expand upon areas and add more clarification where needed.

How conversation takes place is a well-researched area in the field of Linguistics, particularly when it comes to how Feminist Methodologies are applied to this. What remains to be seen, however, is the application of these techniques within CS. Although some research has started to emerge in this area, section (8.2), adapted from one of my publications, poses the need for a union of three methodological practices: thematic analysis, feminist methodologies, and conversation analysis, and contributes a way of using existing methods in combination to uncover any impact of gender on design in CS. This Section summarises a consideration of Conversation Analysis, the existing cross over with feminist research, and presents areas of further research within the field of Computer Science.

When considering the analysis of conversation in design, there are a number of methodologies outlined in the field of linguistics, many of which have already been adapted to be in line with theories surrounding Feminist Methodologies (Sprague, 2016) and therefore may prove valuable. How CA can be brought into alignment with Feminist Methodologies, as stated, is an area that has been researched over many years within linguistics, with Boden (1994) and Holmes (1986)looking at this more historically, and scholars such as E. H. Stokoe and Weatherall (2002) leading the narrative more recently. What remains to be seen, however, is how these can be

applied thematically to the field of CS and the sub-fields within this.

One output of this thesis was a paper (Ashcroft, 2022a), that covered how these could overlap when it comes to methodologies within the field of CS, not just linguistics. The effect a field of research has on a methodology is well understood (Wisniewski et al., 2018), as context is always significant in research, and perhaps even more so when Feminist Methodologies are applied. As this applies to CS, and Human Computer Interaction (HCI) within this, it is important to consider that Feminist Methodologies and "feminism seems well positioned to support HCI's increasing awareness and accountability for its own social and cultural consequences" (Bardzell & Bardzell, 2011). When it comes to Feminist Epistemology, however, "there has been debate between feminists about whether there can be feminist epistemology" (Barbour, 2018), but if epistemology refers to the theory of knowledge and understanding, and the subjects of the research 'have gender', then the argument from feminists that "gender and individual identity are significant in the process of becoming a subject and a knower" (Barbour, 2018; Flax, 1993), then surely they must be relevant in social research. How this applied in CS and HCI, however must be considered, they are areas of research where often logic and structure are seen as important values, and therefore this may clash with the more general understanding of how knowledge is formed. As stated by Hancox-Li and Kumar (2021), "feminist epistemology has long taken a critical stance towards fully formalised systems, instead emphasising the interactive nature of knowledge creation and the importance of exploring multiple possible meanings". This could be argued to be even more important to consider where gendered language is the topic of research, as this research quickly became, as the misunderstanding of language, or its interpretation is key to understanding the effect of gendered language in CS.

8.2.1 Thematic Conversation Analysis

Thematic Conversation Analysis (TCA) is the process and contribution of this thesis and involves applying Thematic Analysis methodologies onto Conversation (Ashcroft, 2020b). Whilst CA relies heavily upon the coding of conversation and specific attention being given to intonation, TCA is more concerned with how things are said through phrasing, as opposed to the overlaps, and more detailed structure (Ashcroft, 2020b) than CA is traditionally interested in (Wooffitt, 2005).

How CA applies to feminist theories is already well understood by the linguistics community, but the impact of gender and language on CS and the products which are continuously designed, used, and built by the CS community has yet to be uncovered in much depth. There is an understanding of the need for variety when it comes to gender to be present and involved in the process, but seemingly very little practical research has been done when it comes to the direct impact gendered language has on

CS and the design processes.

What this thesis has contributed is an understanding of how more inductive methods, such as a thematic analysis, combined with existing knowledge of conversation can be used in order to better understand the accomplishment of the production of project meetings (supporting **RQ1** and **RQ2**.)

8.2.2 Feminist Conversation Analysis

The fundamental principle of Feminist Methodologies lies in the assumption that any prior research or literature may be built upon a patriarchal bias (Sprague, 2016). The removal of this could be argued to be simply good research practice, and any researcher should strive to have no bias in their work, yet since bias is often unconscious, a conscious effort should therefore be made in order to overcome this. Furthermore, Bardzell and Bardzell (2011) clearly outline the differences between "Gender and Computing" as a field of research, and "Feminist HCI methodologies" as the application of feminist methodologies to the field of HCI. This important distinction must be considered, as although the field of this researcher is Gender and CS, and within this HCI, the aim of this reflection is to understand and explore Feminist CA in context. Therefore, when Feminist Methodologies are applied to CA, work by E. H. Stokoe and Weatherall (2002) outlines how an understanding of gender, and the way in which boys and girls are taught to speak, leads onto how men and women do speak. This understanding is paramount when carrying out any observation, recording, and analysis of conversation (E. H. Stokoe & Weatherall, 2002). Throughout their work, they pose that many classic CA traits are not immune to being affected by gender (E. H. Stokoe & Weatherall, 2002). Furthermore, the researchers make comment to the widely argued discussion that "gender difference research is counterproductive for feminism because it reifies the gender dualism and perpetuates stereotypes". However, they also state that although gender is something they "have" and not something they "do" (E. H. Stokoe & Weatherall, 2002), it is important to consider the affect that this, and any other trait a person has, will have on conversation that takes place. This includes not only how words are spoken, but how it they are received. What must be continued to be reflected upon; is the impact this may have on the field of CS, when conversation takes place.

8.2.3 Concluding the Methodological Contributions

Applying a Thematic Analysis to transcripts, with the understanding of the principles of Feminist Conversation Analysis, could be argued to be a vital part of understanding any process with Computer Science. Conversation is seemingly one of the main ways in which decisions are made and interactions take place, even if these are done digitally

(S. Brooke, 2021). Although efforts are continuously made to implore the significance and importance of interdisciplinary research, there seem to be only a few areas of CS where the intersection of gender, language and CS have begun to be uncovered (Ashcroft, 2020b). The importance of this cannot be understated; only by looking for existing areas of research, their suggested methodologies, and applying these to CS, can we uncover if there are any issues caused by gender, and only then action be taken, to overcome these issues.

Traits of conversation, such as turn-taking and overlap, consistently referenced throughout a range of CA literature, must be analysed in industry practices within CS, and other fields within CS (e.g. CS Education), to uncover their significance; and must be done so with feminism in mind. Failing to do so would be a waste of an opportunity provided by the field of linguistics and feminist scholars. By combining thematic analysis with existing knowledge of conversation, this thesis has highlighted how conversation affecting the production of project meetings, as outlined in Section 2.1, within CS design can be understood. Through the lens of feminist methodologies, this thesis has been able to discern and analyse the subtle impacts of gendered language and behaviour within these interactions. This approach not only supports the research questions posed but also enriches the broader understanding of how gender intersects with communication dynamics in professional settings.

One of the key insights gleaned from this research is the importance of adopting an interdisciplinary approach. By drawing upon methodologies from linguistics, feminist research, and CS, the study has been able to provide a comprehensive framework for analysing design meetings. Furthermore, the findings of this thesis highlight the need for nuanced and contextually sensitive methodologies in studying gendered language within CS. The key differential in this work is that of the combination of building upon existing traits of conversation and the inductive nature of thematic analysis.

The investigation into the most insightful methods for uncovering factors that influence the accomplishment of CS design meetings (**RQ2**) has yielded insights into the use of methodological practices from both linguistics and feminist research. As the thesis explores the nuances of CA, it highlights their potential to be adapted and enriched by the principles of feminist methodologies, which is a well-established practice within linguistics (Boden, 1994; Sprague, 2016; E. H. Stokoe & Weatherall, 2002). Whilst CA offers distinctive advantages and limitations in analysing the functional and sense-making properties of language (Wooffitt, 2005), their integration with thematic analysis and feminist lenses allows a more comprehensive perspective on the impact of gendered language within the field of CS and design.

The alignment of these methodological approaches with feminist principles, as outlined throughout this thesis, reflects the significance of considering not only the functional aspects of language but also the nuances between of power dynamics, identity, and subjectivity in communication. By addressing the sub-question (**RQ2.1**

- How can these methods be informed by existing feminist methodologies?), the thesis outlines that these methodologies can and should indeed be informed by existing feminist methodologies. Recognising that gendered language and behaviour play a significant role in shaping communication dynamics aligns with the core principles of feminist research. This makes combining these methodologies with feminist principles a logical and valuable step forward. Furthermore, this thesis outlines that the exploration of gendered language in the context of CS requires a nuanced approach, one that allows for the dynamic and interactive nature of knowledge creation while accommodating the logic and structure inherent to the field. The combination of conversation analysis, thematic analysis, and feminist methodologies emerges as a promising avenue for investigating the dynamics of design meetings in CS through an interdisciplinary lens.

8.3 Conceptual Contributions

Large proportions of this Section (8.3) informed much of a publication from OzChi in 2021 (Ashcroft, 2021b) and a further publication at ECSCW 2022 (Ashcroft, 2022b), but amendments have been made in this thesis to expand upon areas and add more clarification where needed.

Chapter 2 outlined the current issues with gender and CS as a wider concept, and brought forward innovation practices, design principles and how these may overlap. Furthermore, when it comes to design meetings, as these most happen through language and talk, as does most business (Boden, 1994), principles of CA have been examined through a feminist lens with a view to how these may affect digital design decisions, and the sense of belonging of participants in a room.

Figure 8.1 was shared by academic artist and writer Fosslien (2022) on LinkedIn, and illustrates how people may be more open to sharing ideas if they feel they belong. This Section examines this, when it comes to gender, in much more detail, and exposes the gap in literature, that this research aims to complete.

One of the key areas which emerged in this thesis was the existing work from linguistics around Hedging, and how this can affect conversation surrounding design. What this thesis has presented, particularly in Chapters 5 and 7, is how Hedging is used by men and by women, and how this ties back into existing work on frequency and intention. The impact that this has on the design process is still yet to be explored, and should continue to be done beyond the scope of this thesis.

RQ3 aimed to uncover which concepts are the most useful for understanding the accomplishment of design in CS, and what this thesis has outlined is the potential impact of Hedging on the way in which teams work together to carry out a process within design. As outlined in Section 1.5.4, design in this thesis is defined in the

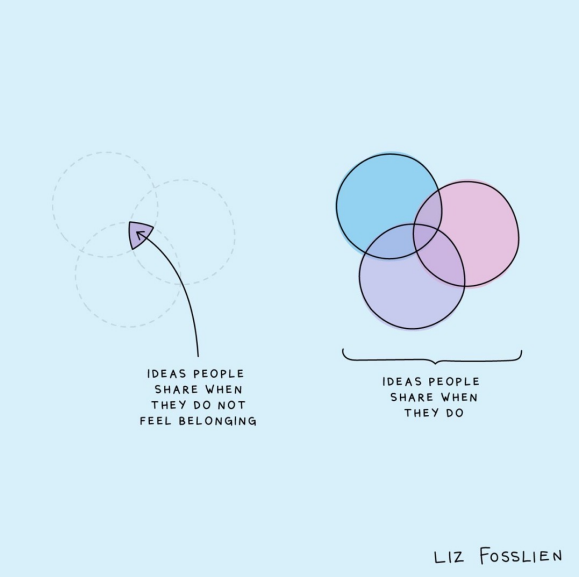

Figure 8.1: Artwork shared on LinkedIn by artist Fosslien (2022), co-author of Hard Feelings.

broader sense of creating solutions to problems. This fits into a wider process in business, the most common of which in CS is the Software Development Life-cycle. In order to answer **RQ3**, and the sub questions **RQ3.1** (how are these concepts affected by gender?) and **RQ3.2** (how is design impacted by concepts such as Hedging, interruptions, emotional labour and project work?), this Section (8.3) outlines how this may impact the process that software design fits into through the Software Development Life-cycle.

The need for software and how this is raised, the specification, the development, the validation and the evolution Sommerville (2016), are all impacted by conversational and may be affected by "Hedging", its uses, and gender (Sections 8.3.1 - 8.3.5). In order to answer **RQ3**, **RQ3.1** and **RQ3.2**, this thesis makes a number of conceptual contributions as to how Hedging can impact the wider design process.

8.3.1 The Need for Software

How the need for software or digital intervention is raised will vary between organisations and context, as shown in the differences between how Hedging was used in a university setting compared to an industry one. Some smaller companies may have a more informal model, while other companies may have a systematic process that is followed and applied to all suggestions. More realistically, it could be argued, it is more likely for the truth to lie somewhere between the extremes.

Project proposals serve as a means for idea initiation (Heemstra & Kusters, 2004), emphasising the importance of evidence-based proposals and stakeholder engagement, though the influence of "Hedging" in this context remains to be researched. Although "Hedging" may or may not be explicit in proposals themselves, the presentations of initial ideas, or presenting the proposals themselves, may be affected by "Hedging", and therefore their likelihood to be accepted may also be affected. *Problem raising*, a common method for project initiation (Ashcroft, 2020a; Park, 1996), may be significantly affected by "Hedging," potentially leading to differences in how issues are perceived based on language use, e.g. "I think we should fix this issue", which is particularly relevant to gender dynamics. Furthermore, *innovation practices* such as Adobe's Kickbox ("Kickbox Foundation", 2021) involve discussion-driven stages susceptible to language influences, including gendered language.

Regardless of how ideas for software needs are introduced, whether through project proposals, issue raising, or innovation, language plays a critical role. **RQ3.2** (how is design impacted by concepts such as Hedging, interruptions, emotional labour, and project work?) can be answered through the conceptual contributions of this work: this author suggests that language traits like "Hedging," known to be influenced by gender, can affect the reception and consideration of these ideas. Consequently, it is vital to recognise that even before the software specification process begins, some valuable ideas or changes may have already been marginalised within a system that does not equally empower all members of society to be heard, understood, and valued. Further research, beyond this thesis, should explore this aspect in conjunction with alternative methods of expressing the need for software.

8.3.2 Software Specification

Software specification is the first stage of Software Engineering as defined by Sommerville (2016). How software specifications, or requirements, are gathered varies based on the selected methodology, as well as the organisation or individual in question who is carrying it out. However, most agree that it should include the involvement of all stakeholders, including users of the system. How these are documented can also vary, from requirements listing in Waterfall methodologies (Dima & Maassen, 2018), to User Stories in Agile (Agile Alliance, 2020).

Through both the gathering and recording of requirements, language is instrumental in how this takes place. If the stakeholder engagement is done through *written formats* such as emails, instant messaging or surveys, there are many ways in which language will affect the interaction. If they are done through *spoken interaction*, e.g. video calls, audio calls, or in-person meetings, this also leaves room for misinterpretation, the personal preferences of individuals overriding, or what is recorded as the correct process i.e. human error. People are not without their bias,

however unconscious.

However, it could be argued that it is not just the perception of these interactions that will affect the specification stage, but how current issues or ideas are raised. If "Hedging" is used, then perhaps those who use it, often women (Holmes, 1986), may be less likely to be heard and understood. What should be researched further is a deeper understanding of the effect of "Hedging" on this stage, and if any negative causation is found, what can be done to mitigate the effects of this.

What should also be considered here is when these are defined through discussion, who writes this down (as discussed in Section 5.3.3.1). Some may argue that women being the default scribe may stop them from being able to fully engage within the meeting (Forbes, 2013), whereas others may suggest that this gives the person making the notes power, as they get to choose what is recorded. Regardless, the implications for this on the end product require further research beyond this thesis. Furthermore, is choosing what to write down a form of emotional labour (Hochschild, 2019), or at the very least *invisible*, and does this also more often fall to women for the same reason? This too should be researched further beyond this thesis and the mainstream articles that already exist (Forbes, 2013).

8.3.3 Software Development

Software Development is the second stage of Software Engineering as defined by Sommerville (2016), and is often carried out by men due to the in-balance in the field, with just 11% of software developers being women (Criado Perez, 2019).

Beginning with the interpretation of the requirements, this may be affected by language in both how they have been written, and how they are understood, and as, again, this is done through language, this must also be researched further to find any potential areas of difference regarding gender. It is the subtleties here, as discussed in Chapter 5 which could prove telling.

Regarding the programming itself, how men and women code and approach the problem has also previously been shown to be different (Ashcroft, 2018; Terrell et al., 2017), but how this may be affected by "Hedging" remains to be seen. Although language will have an impact on their interactions throughout the process (Ashcroft, 2018), for example in discussing how a problem or requirement should be approached, if and how the code itself differs due to a direct impact of "Hedging" remains to be seen. Previous work in this area does however indicate that approach in the code will differ based on gender and single sex groups (Ashcroft, 2018), the examination of differences when mixed groups are observed could also prove interesting. Although existing literature shows that development is affected by gender, the specificity of the effect "Hedging" has on this remains to be seen, and definitely requires further investigation.

8.3.4 Software Validation

Described as the third stage, Software Validation is vital to ensure the software that has been created meets the requirements outlined at the beginning of the process (Sommerville, 2016) (see Section 8.3.2), therefore, not only must this step allow for equal representation and equity, but it relies on the same being said for the specification stage. Though testing takes many forms, some of which can be automated, there is also the need to involve as diverse a range of testers, as there are users.

When it comes to how language can affect the Software Validation stage, how users are asked, and listened to in their responses should be carefully planned, considered and analysed. For example does "I think it's good" carry the same weight as "it's good". It is still, of course, important that testers are listened to and comments noted if there is a problem with the tested software, but also that their comments are taken seriously regardless of whether "Hedging" is used.

8.3.5 Software Evolution

The stage of Software Evolution recognises the need for continued development and support of systems once they are built and implemented (Sommerville, 2016). This software being correct and appropriate for use, is of course dependent on the correct specification, development and validation; but this stage may also leave room for a lack of input, or a misinterpreted output from all stakeholders. This could, for example, reflect similar practices to problems being raised, and the rest of the process being cycled through; and therefore all the above potential implications of "Hedging" once again apply.

8.3.6 The Potential Effect of "Hedging"

The overall process of ideation through to implementation involves discussion and the use of language throughout. Although the amount of discussion may vary from stage to stage, and this may also vary between organisations, what is consistent in practice and literature, is that this does occur. With existing research on language, gender, and "Hedging", it seems that there is a gap in the literature when it comes to how these areas affect the Software Engineering process in its entirety. Although literature has begun to emerge on its effect on the design process (Ashcroft, 2021b), the rest of the process, from the need for software to its evolution, remains to be researched further with regards to gendered language. The effect of "Hedging", or other existing known gendered differences in language, should be examined alongside each process within Software Engineering to fully uncover "Hedging" as a feminist issue in CS.

8.3.7 Concluding the Conceptual Contributions

Software development, is a process in which designers, developers, stakeholders and users are involved throughout the entire process (Burkett, 2012; Harrington & Dillahunt, 2021). Therefore it stands to reason equal representation is crucial in the designing and creation of software, as the users of the software themselves are often a diverse range of people. However, it is clear that representation and being in the room is simply not enough. There is very little reason to have representation in the room, if they are not heard, respected, or even given the opportunity to speak. The role "Hedging" plays in this is one of vital importance, and is neither the fault of the individual men or women in the room, but a product of how they were all raised- for example men are significantly more likely to express opinions as certainty, in comparison to women (Holmes, 1986). The societal and systemic raising of children into adults in this way continues to perpetuate a cycle where men feel they are more confident in their opinions, and more likely to express them as facts; and women are much more likely to use "Hedging" as a linguistic tool to express uncertainty, perhaps when there is none, as a means of *taking up less space*.

Therefore, the impact that this has on software, the tools used by many in their day-to-day lives, as part of social interactions, work and for countless other reasons, cannot be understated. If women in design meetings are not listened to, due to the use of "Hedging" or otherwise, how can it be guaranteed that the software, or even hardware, that is created is appropriate for use? There are countless examples of technology not being suitable for wider groups making it into the market, with a release of the aforementioned Apple Watch's battery life not lasting for those with pigmented skin (BBC, 2015), or phones being designed for the average size of men's hands and not women's (Criado Perez, 2019). These are products designed by large companies with the budget and resources to ensure that these mistakes are not made, and yet consistently they are. Which leads this author to assume it is not a lack of ability, but a lack of willingness. With men being more likely to achieve positions of leadership, regardless of past experience (Reuben et al., 2012), how can it be ensured that their best interests are to support those who do not reflect their experience of life? It could, of course, be argued that empathy is a means of overcoming this, and by being able to place themselves in the shoes of others they would be able to see what is needed from the perspective of all potential users, which could also be argued to be the trait of simply a good designer. However, this only works if all information is openly and willingly shared and known, a designer does not know what they don't know e.g. if a designer does not know that on average women's hands are smaller than their own men's hands, how would they then practice empathy in order to change their design?

The above makes the case for representation in the room but does not discuss what happens once equal representation is present, the situation is arguably only

slightly improved if when people of varying genders, races and backgrounds are in the room, and will only be significantly improved once they are listened to. As discussed, the effect "Hedging" can have on each stage of the Software Engineering process is potentially quite large, but needs to be researched further to be understood on a more complex level. Furthermore, when considering Feminist Methodologies, as discussed in Section 3.1, these must also be reflected within the scope of Language and HCI more specifically.

The conceptual contributions of this thesis outline the critical importance of addressing the research questions that form the core of this study, particularly **RQ3** (what concepts prove most useful in the examination of gendered interactions in project meetings?). Equal representation within software development and design processes is essential, considering the diverse range of users that software serves. However, representation alone is not enough if marginalised voices are not given the space to be heard and respected. This speaks directly to Research Question 3 and its sub-questions (**RQ3.1** - how are these concepts affected by gender? and **RQ3.2** - how are concepts such as Hedging, interruptions, emotional labour and project work impacted by this?), which delve into the effects of gender on concepts like "Hedging," interruptions, emotional labour, and project work within CS design processes. By exploring these concepts through the lens of gender dynamics, this thesis outlines the nuanced ways in which gender influences the accomplishment of design and the consequent software that emerges.

The linguistic phenomenon of "Hedging" emerges as a pivotal factor, outlined not only by individual linguistic traits but also by broader societal and systemic influences. Addressing these issues is not just an academic exercise; it carries tangible implications for the quality and inclusivity of the technology that underpins modern society, and shapes how business is done. **RQ3**, alongside **RQ3.1** and **RQ3.2**, expose the intricate relationship between gender and these concepts, shedding light on their potential impact on the overall success of design practices. This thesis suggests that research should go beyond identifying linguistic patterns; and delve into understanding the underlying power dynamics, biases, and barriers that shape communication dynamics withing CS and design. In doing so, it contributes to the larger discourse surrounding gender, communication, and design within the field of Computer Science.

8.4 Design Contributions

The culmination of this thesis must outline an answer to **RQ4** (what are the implications for design of this research?) and its corresponding sub-question **RQ4.1** (how does this impact our understanding of success or failure in design?), both of which demand answers on the implications of the research findings for the realm of design within the field of Computer Science. As the preceding chapters have

elucidated the intricate interplay between gender, communication dynamics, and the accomplishment of design, it is important to understand how these insights reshape our understanding of design processes and outcomes in Computer Science.

The multifaceted dimensions of design, as it interfaces with gender-influenced communication, bringing to the fore a nuanced understanding of what it means for a design to be successful and inclusive. This ties back into Dourish (2006)'s implications for design and the need for understanding users and designers, but outlines the importance of understanding the impact of gendered language in the discussion that happens between those involved.

Furthermore, when it comes to **RQ4.1** and how this research contributes towards the success or failure of design, the following recommendation is made:

> *Success or failure cannot simply be measured based upon if the product designed is fit for use, but must consider the impact and emotional labour of those involved.*

This thesis highlights the importance of conversation when considering design in a CS setting, and how this impacts designers and users, building upon the work of Hochschild (2019). Considering different personality types and protected characteristics when designing for interactions in real-world settings is important when it comes to understanding these interactions. Design in a closed setting, such as the ones seen in Chapters 4, 5 and 6, often focuses on individual personality types such as Myers (1962). However, real-world design requires examining how different groups interact, which shapes the design process.

Design emerges through collaborative interactions between various stakeholders, and business is conducted through talk Boden (1994). Design in the real world must account for diverse perspectives, needs, and power dynamics. An inclusive design process considers which voices are represented, who has decision-making power, and how to mitigate biases.

This research contributes an interaction-centered perspective on design. Rather than viewing design as a process enacted on passive users, it is framed as an emergent and participatory process of social interaction (Burkett, 2012; Harrington & Dillahunt, 2021; Harrington et al., 2019). Successful industry design requires facilitating positive interactions among all stakeholders throughout the process, the power of which is established in existing research (Flynn et al., 2008; Khanna, 2020; Purdy & Borisoff, 1997). This was shown consistently through the leadership displayed in Chapter 7, through active listening and supportive statements. Fostering open communication, mitigating power imbalances, and ensuring all voices are heard are vital traits of a conversation that enables equal participation.

In summary, this thesis expands design discourse by emphasising real-world interactions between diverse personalities and protected groups. It advocates for

more participatory and inclusive design processes in industry settings. This provides a valuable direction for human-centered design and CSCW moving forward.

8.5 Final Conclusions

Throughout this thesis, a series of case studies have been presented, each contributing findings and highlighting various aspects of communication dynamics within different contexts. In Chapter 4, the pilot study highlighted the importance of managing audio quality during group discussions and suggested the need for further investigation into potential gender differences. This prompted exploration into innovation workshops within a university setting in Chapter 5, where gender dynamics manifesting through language use and group practices were observed. The implications of these observations for the design process emerged as a critical area for further examination. In Chapter 5, an analysis of Hedging usage, using transcripts from the previous Chapter, revealed no statistically significant gender differences, but the study's small sample size prompted the investigations of the implications of these findings for design processes. Then, due to the Covid-19 pandemic, no further workshops could happen in person, and an online approach was taken. Therefore, in Chapter 6, an online workshop was run to uncover how technical difficulties and the online environment influenced workshop dynamics, reinforcing an understanding of gender-related patterns in idea generation. However, to gain a broader perspective, industry meetings in Chapter 7 were observed. The investigation into communication dynamics between academic focus groups and industry meetings uncovered context-specific variations and the significance of fostering inclusive team cultures. The leadership approach and emotional labour demonstrated by the leader of the team in industry, offered intriguing insights into the impact of gender dynamics in such settings. Additionally, the case study unexpectedly sparked discussions on LGBT+ and gender topics, accentuating the need for more ethical and inclusive practices in natural language processing.

Overall, these chapters have provided an exploration of communication dynamics within university settings and a software design team, with implications for fostering creativity, collaboration, and inclusivity in the future. It is important to consider Generalisation once again here, as discussed in Section 3.5.2, as this thesis provides individual examples of this work. But what each setting has shown is areas of interest as well as methods that can be used to explore these. These settings show that Computing and design are linked and can be explored for the impact of gendered language. Historically, Computing and design were each seen as an independent task, the work being done was reflecting this, but what is observed in this thesis are examples of how the interactions of this project work can be impacted by both gender and talk. This series of case studies have led to the outlining of how to apply

existing methodologies in a CS setting (Ashcroft, 2022a), and seeing examples that both support and contradict existing research when it comes to gendered language in CS.

Empirically, this thesis makes contributions to research on gender dynamics and communication patterns in group contexts. The findings from the innovation workshop study in Chapter 5 revealed subtle gender differences in areas like problem framing and language use, supporting existing linguistics research on gender conformity (Kitzinger, 2008; Lindqvist et al., 2019). The Hedging analysis in Chapter 5 compiled gendered language practices but did not find significant quantitative differences, prompting further contextual analysis. Finally, the industry case study in Chapter 7 uncovered more balanced participation versus student groups, aligning with research on gender and organisational talk (Boden, 1994). This highlights the complexity of gender influences across settings.

Methodologically, combining qualitative techniques like thematic analysis, feminist frameworks, and conversation analysis enabled nuanced investigation of gender and language issues in computer science design processes (Ashcroft, 2022a). This interdisciplinary approach has the potential to uncover subtle dynamics missed by other methods.

Conceptually, the thesis emphasised diversity in the room is insufficient if marginalised voices are not respected or empowered to participate (which led to publications in this area; (Ashcroft, 2021b, 2022b)). Gendered language practices can perpetuate biases if unaddressed and supported through a case study that software development must involve diverse perspectives (Harrington & Dillahunt, 2021).

For design, this research advocated viewing it not as acting upon users, but an emergent, participatory process in line with the contributions of Harrington et al. (2019). Fostering inclusion and open communication enables successful human-centred design. Existing research focuses on gender and design, or design and emotional intelligence, and this thesis calls for these three areas to be looked at at once to uncover any potential impact.

This thesis contributes towards furthering the understanding of gender dynamics and promote equitable participation across contexts. Limitations like small samples sizes indicate more work is needed to deepen these insights. However, the combined empirical, methodological, conceptual, and design perspectives provide valuable guidance for enhancing creativity, collaboration, and inclusion in computer science fields.

Overall, this thesis has provided an exploration of communication dynamics within different contexts, with implications for fostering creativity, collaboration, and inclusion. This series of case studies led to outlining how to apply existing methodologies in a CS setting, and provided examples that both support and contradict existing research on gendered language.

Contributions of This Thesis

RQ1 - What influence does gendered language have in the production of project meeting outcomes?

Project meetings require emotional labour from participants, and this can also be seen in CS design meetings, although in different ways throughout the case studies. The factors that have observed to be important throughout this thesis include classic CA traits such as turn taking and overlaps (Chapter 5), through to themes inferred from the data such as how problems are raised and how LGBT topics are discussed (Chapter 7).

RQ1.1 - To what extent does gendered language and behaviour impact the accomplishment?

This thesis contributes empirical insights into gender dynamics, Hedging in design workshops, and communication patterns in software design teams. Chapter 4 examines gender dynamics in innovation workshops, revealing gender conformity and differences in design processes. Chapter 5 explores Hedging in design workshops, highlighting the need for nuanced analysis in understanding its impact. Chapter 7 compares communication dynamics between academic and industry settings, showcasing gender-related variations. These findings underscore the significance of gender in group interactions and design processes, emphasising the importance of recognising gendered language's impact on communication and the need for inclusivity in Computer Science.

RQ2 - What methods are the most insightful for uncovering factors that impact how design meetings are accomplished?

This thesis addresses the questions of what methods hold the most insight in unraveling the factors shaping design meeting accomplishments. Through an exploration of Conversation Analysis (CA) and Thematic Analysis (TA) within the context of Computer Science, the research highlights the potential of these linguistic methodologies. .

RQ2.1 - How can these methods be informed by existing feminist methodologies?

This thesis also outlines the need for acknowledgement that the integration of feminist methodologies enhances the efficacy of CA and TA, aligning with the fundamental principles of feminist research. This integration is not only feasible but crucial, reflecting the dynamic interplay between the concepts of gendered language, communication dynamics, and design processes in Computer Science

RQ3 - What concepts prove most useful in the examination of gendered interactions in project meetings?

This thesis shares critical conceptual contributions that outline the core dynamics of design in the realm of Computer Science (CS). Through exploration, it becomes evident that gendered language and behaviour, equal representation, and nuanced understanding of linguistic patterns such as "Hedging" are vital to comprehending how design is done in CS settings.

RQ3.1 - How are these concepts affected by gender?

The exploration of gender's impact on these concepts reveals a nuances between between linguistic behaviours, societal conditioning, and power dynamics. Gendered language practices, shown thrown the linguistic trait of "Hedging," for example, are not only a product of individual linguistic choices but are also shaped by systemic biases. These biases can lead to unequal representation, power imbalances, and varying levels of emotional labour, all of which manifest in design processes within CS.

RQ3.2 - How is design impacted by concepts such as Hedging, interruptions, emotional labour and project work?

The examination of the influence of gender on concepts such as "Hedging," interruptions, emotional labour, and project work elucidates their profound impact on design accomplishment. Gender disparities in language practices, such as Hedging and interruptions, may lead to unequal participation and hinder effective collaboration. Emotional labour, which is impacted by gender, affects communication dynamics, team dynamics, and decision-making processes. In addition to this, the intersection of gender with these concepts reveals the need

for more inclusive practices and efforts to mitigate biases and barriers in CS design settings.

RQ4 - What are the implications for design of this research?

The summary of this thesis underscores the implications of gender-influenced communication dynamics on design within CS. By outlining these dynamics between gender, language, and design, the research emphasises that successful design must encompass inclusive conversation and equitable participation, transcending the traditional understanding of design as a product-focused endeavour, supporting the work of Dourish (2006) but extending this.

RQ4.1 - How does this impact our understanding of success or failure in design?

The research findings throughout this thesis lead to a recommendation to shift the assessment of design success or failure. This thesis advocates that evaluating design outcomes must go beyond functional usability, and must incorporate considerations of emotional labour, diversity, and the dynamics of gendered language. The recommendation to recognise the impact on participants' experiences introduces a new dimension to the understanding of design, emphasising the necessity of empathetic and inclusive processes for achieving success in design.

In summary, this thesis makes contributions to furthering the understanding of gendered language dynamics and promoting equitable participation. The research questions guided empirical examination of participation patterns, methodological combining of techniques, conceptual arguments for inclusion, and design perspectives on emergent processes. While limitations exist, these combined perspectives and case studies provide valuable guidance for enhancing collaboration and creativity across CS.

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